THE ENGINEER.

Some Continental and British Machine Tools.

CONTINENTAL MACHINE TOOLS.

THE fact which, it seems to us, was most clearly proclaimed by the display of machine tools at the Paris Exhibition is the growing cosmopolitanism of machine-tool design. It is, indeed, still possible for the close and experienced observer to distinguish characteristics peculiar to each nation, but, except in a few instances, the divergence in type between any two nations is not more pronounced than the differences in the products of two makers of the same nationality. There is not that divergence of design which is so pre-eminently marked in locomotives of British, continental, and American origin, nor that varied realisation of the same ideas which is seen in naval architecture or ordnance; nor have we, as in stationary engines, the sharply-marked division between the elaborate engines of continental origin and the severely simple designs of American and British types. The designs of machine tools have become universal, and both in the matter of form and workmanship there is little or nothing to choose between the nations.

This cosmopolitanism, as we have called it, of design, may mean one of two things. It may mean that we have arrived at a stage where the wit of man has come to a temporary standstill; or it may mean that the ultimate has been reached, and that nothing further, nothing radically different in design, is to be expected. It is impossible to say which position we are in. When we look at a modern machine tool in action, be it large or small, we are tempted to say that further change is impossible, that we have reached the bed rock as far as the general design is concerned. But if, again, we consider how little is yet known of the services of electricity in metal working machinery, we defer our conclusion that finality has been attained. At present electricity is applied to machine tools in a form that is but little more than a makeshift. Even in the machines designed to incorporate the motor, the belt and gearing are very generally used. In these pages will be found numerous cases of this application of the motor. Surely improvement is to be looked for here. It requires little inventive talent to picture a full automatic electrical machine tool, a machine in which the spindle would be driven by the motor without the interposition of belting and a long train of gearing, and in which all the automatic movements would be secured by separate motors, magnets, and solenoids, disposing once for all of the intricacy of mechanism which consumes as much or more power than it usefully expends. It may be recalled that compressed air has been used to effect a similar purpose. Such an electrical device would constitute an entirely new departure in machine-tool design. But it is difficult to foresee any other direction in which sweeping changes may take place as long as the present principles of working metal obtain, and we are led to the conclusion that, in the general design, finality has been almost reached in nearly all cases. It is hardly necessary to say that in the tools shown at the Exhibition, the influence of America was very pronounced, but Englishmen may well remind themselves that this country was the birthplace of the industry, and that the characteristics of the higher British designs of machine tool have never been departed from, and are still the standards for design the world over.

The present Supplement is principally devoted to machine tools of continental origin, for the study of which the Paris Exhibition afforded exceptional opportunities. In this country we are less well informed than we might profitably be of the progress of engineering in this line across the Channel. This is due in no small degree to the unwillingness of continental makers to afford information and assistance. The same unwillingness has rendered the preparation of descriptive articles of the machine tools exhibited at Paris by French firms a difficult matter. German makers we have found far more willing to allow of the fullest investigation and to provide detailed particulars of their products.

Machine tools of British manufacture, exhibited at the Paris Exhibition, are not dealt with at all in this Supplement. We have already described the tools shown by Kendall and Gent, and the ingenious bevel gear cutter exhibited by Smith and Coventry, in our issues of September 9th and August 24th, and on a future occasion we shall describe some of the machines made by the few other British makers who exhibited in this class.

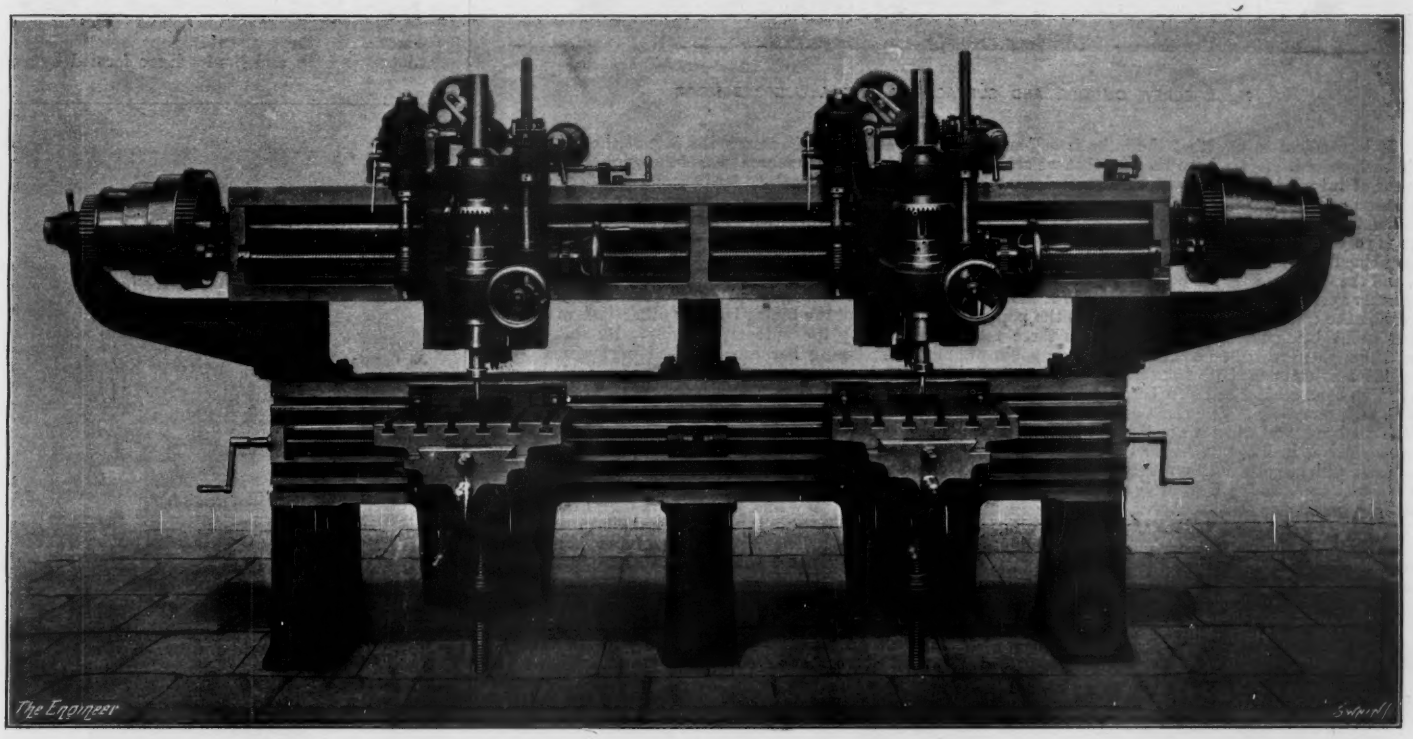


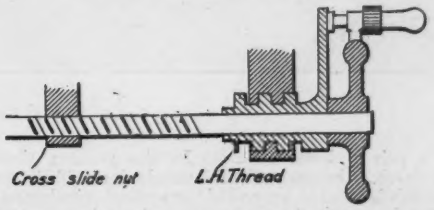
Fig. 1—DUPLEX MILLING MACHINE—ATELIERS DEMOOR

ATELIERS DEMOOR, BRUSSELS.

The Ateliers Demoor is a Belgian house, and its works are in Brussels. The Belgian Government apparently followed the example of the French Government in the case of Usines Bouhey, of which more anon, and either consented or desired that certain tools ordered by them should be shown at the Exhibition. In this case many of the tools belong to the Administration des Chemins de fer de l'Etat Belges. The only matter for regret on this account is that there was not such a variety as the firm would like to have shown. We have before us an excellent souvenir presented by the Ateliers Demoor, and looking through it we see many tools which would have formed interesting exhibits, but which on account of the limitation of space it was impossible to show.

A fine tool shown by this firm is the double milling machine illustrated above—Fig. 1. It is one of those designed for the Etat Belge. The maximum distance between the tool centres is 8·25ft., and the vertical travel of the tool is 9in. It is intended principally for keyway cutting, and similar work. There are two exactly similar independent tool heads, which travel longitudinally, and reverse automatically at each end of the desired stroke. The descending movement is also self-acting, either continuously for drilling or intermittently by ratchet and pawl for keyway cutting. Both movements can, of course, be made by hand when desired. All levers and hand wheels are on the two heads, and any action can be thrown out instantaneously. The vertical slides are balanced. The general working of the tool, as well as other points of interest, will be gathered from the engraving. An interesting type of double milling machine with two circular tables is made also for the State Railways by the Ateliers Demoor, and is used largely for machining the ends of coupling and connecting-rods, but there was not space to exhibit it.

In many of the machine tools at the Exhibition there were indescribable characteristics which at once struck an Englishman. In those of the Ateliers Demoor this foreign air is absent, nearly all the tools bearing a close resemblance to American and British models. This will be appreciated at once by an inspection of the illustrations we give. Take, for example, the lathe shown in Fig. 2; it has the appearance of a combination of American and English designs, with a substantial preponderance of the former. It is a fine tool in every way. The shears are deep and strong; the carriage slides upon three inverted vees, two in front and one behind. It is held down at the back, but not in front.



Two means of traversing are provided, a rack and a leading screw; the latter is used only for screw cutting, the ordinary feed, either by hand or by power, being effected by the rack. The automatic feed is operated by the lower shaft seen in the front of the lathe. All the motions are regulated from the front of the saddle. A pretty, though by no means new, device for facilitating screw cutting is fitted. The cross-side screw passes through a bush which has a square left-handed thread of rapid pitch cut on its exterior face. A handle forms part of this bush, and the "crank pin" part of the handle stands out over the edge of the cross traverse hand

wheel. The latter is notched round the edge, and a pawl hanging from the "crank pin" engages with the notches. The rough diagram above will make this clear. The cut of the tool is set by turning the hand wheel, say, one notch by the pawl; it is withdrawn quickly by turning the bush lever rapidly to the right, which has the effect of pulling back the cross slide without turning the screw.

Another point worth mentioning is the method of carrying the tool. The top of the slide or tool box has a concave face, in which a piece of steel about the width of the tool, and in length about equal to the diameter of the cavity, rests. It has a flat top on which the tool lies. This piece, it will be understood, can be rocked or inclined, within certain limits, to vary the angle of the tool. It is needless to say that the lathe is self-acting and is back-geared. Apart from the fact that we are not in favour of inverted vees, it must be admitted that in both design and workmanship this is a fine tool.

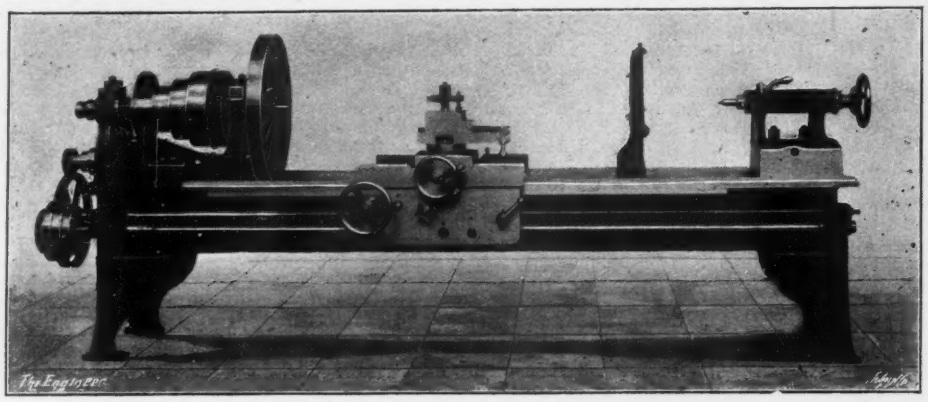


Fig. 2—SCREW CUTTING AND SURFACING LATHE—ATELIERS DEMOOR

We illustrate also a *tour a trois pointes*, of which the design is very neat—Fig. 3. The bed is practically double, the combined loose heads sliding on one set of inverted vees, and the carriage with the back stays, &c., on another pair further apart; this plan has been adopted for the sake of allowing the carriage to travel close up to the poppet head without being unsuitably short. The three tool boxes, although mounted on one carriage, are capable of independent adjustment, both transversely and longitudinally. The back centres can also be adjusted independently in both directions. The same device for withdrawing the tool rapidly when screwing, which we have described above, is fitted. The method of driving the three heads will be gathered from the engraving. It will be noted that the gearing is entirely protected, and that the drivers are of the Clements type.

A useful little machine is that illustrated in Fig. 4, and designed for turning bolts. It was exhibited in two sizes, of which we show the larger. A counterbalanced vertical spindle is driven through a clutch by a pair of bevel wheels. In the position shown the clutch is thrown out by the simple device illustrated. The bolt is fitted in the end of the vertical spindle, and is pulled down against tools fixed in the table, by a mariner's wheel, or by power through the inclined shaft and universal joint. The bolt can be turned of one diameter throughout or of different diameters, and the end is rounded and the face of the head machined. The tools themselves consist of short pieces of square steel cut from the bar and ground. In the smaller machine the spindle is brought down by a lever. It can turn up to ·8in. diameter by 6·4in. long. In the larger machine the descent is effected and arrested automatically. It can turn up to a diameter of 1·4in., and a length of 9·6in.

Amongst other tools shown on this stand was a lathe designed specially for taper turning, tapping, &c., in which a back shaft driven by variable gear plays an important part; a small face-plate lathe—called in French a *tour en l'air*—which takes a maximum diameter of 44in.; the total length of the bed is about 6ft. 6in., of which the greater part is taken by the poppet head. There is, of course, no back centre. A compound slide rest with self-acting motions without ratchets is provided, and the head is back-geared and fitted with reversing motion for the feed; an ingenious twist drill grinder, in which a worm on the wheel spindle drives a crank which reciprocates the tool-holder backwards and forwards across the face of the wheel. At the same time the drill is rotated backwards and forwards about its own axis by a pair of toothed quadrants. By replacing the quadrant gear by a suitable chuck for holding ordinary turning tools at any angle, they are caused to move back and forth across the face of the stone by the crank motion, and unequal wear of the stone is thus avoided.

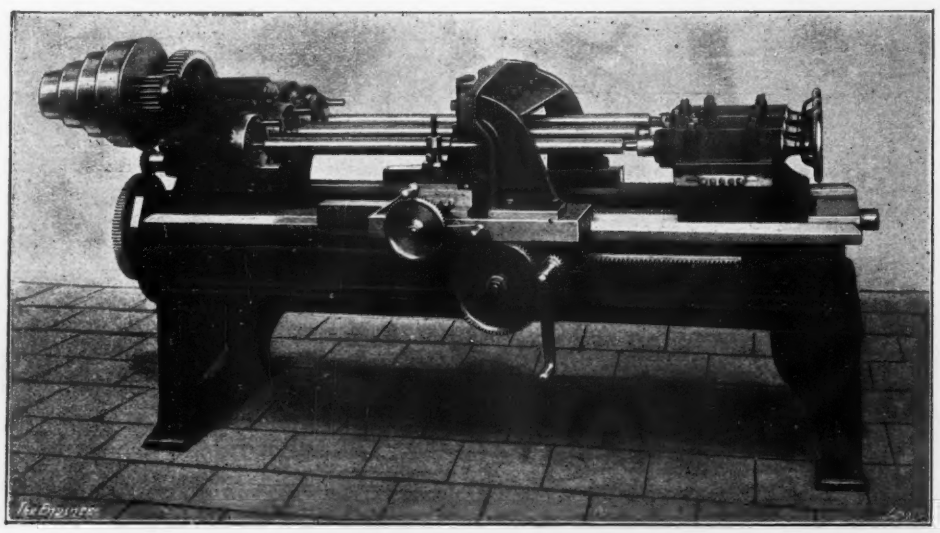


Fig. 3—TRIPLE LATHE—ATELIERS DEMOOR

A substantial machine for boring locomotive cylinders made on a plan devised by M. l'Ingénieur-en-chef Degraux for the State Railway shops was also shown. It consists of a long broad bed having fixed at one end a broad upright column on which a carriage slides vertically, and at the other a lighter column with a bearing capable of vertical adjustment. A long snout on the carriage receives the driving end of the boring bar, the other end of which is supported by the outboard bearing. By this arrangement the boring bar can be raised or lowered to suit the cylinder. The cylinder is clamped to a table mounted on the bed, and provided with a cross slide. The feed is effected by moving the cylinder, not the tool, and friction gear is employed for the purpose. Worm gearing is used to rotate the boring bar. The maximum size of cylinder which can be machined is about 34in. diameter by 36in. long. The total length of the bed is about 18ft. It is a very fine tool, and we regret that we have not space to illustrate it. A double milling machine, also for the State Railway, consisting of two poppet heads capable of adjustment in slides to or from each other, and an adjustable table between them was exhibited. The spindles are driven by two belts on single pulleys, which contain gearing for altering the speed. The table traverses automatically, and a self-acting circular table can be fitted to it when desired. A simple machine for facing nuts or bolt heads, and two grinding machines, one of which has a horizontal and the other a vertical table, both fully automatic, complete the list of the Ateliers Demoor exhibits. We have, however, selected from the souvenir already mentioned two other tools made by them but not shown at Paris. The first is a triple back gear self-acting *tour en l'air*, with two compound slide rests—Fig. 5. It calls for no particular comment, unless to remark on the excellence and substantiality of the design. In all respects, judging from the photograph, it is such a tool as might have been designed in this country. We illustrate also a large milling machine, Fig. 6, probably intended for the dressing of edges of armour plate, facing heavy castings, and similar work, which is practically self-explanatory.

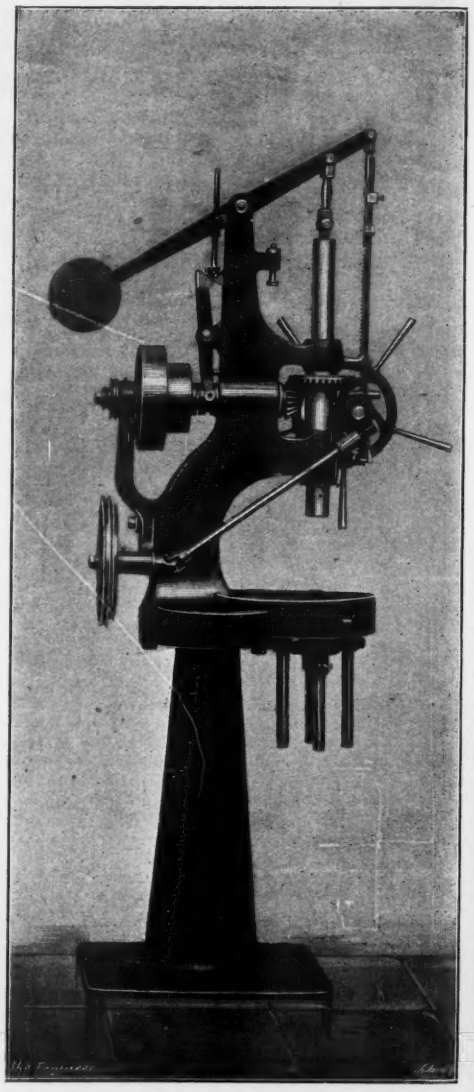


Fig. 4—BOLT TURNING MACHINE

USINES BOUHEY, PARIS.

It is impossible to pass the machine tool section of the Exhibition in review and to leave the Usines Bouhey unmentioned. It may be said, we think, without fear of contradiction, that their exhibit was the most remarkable in this section. It consisted principally of very large tools, made, we understand, to the order of the Government for use in the national arsenals. We regret that the particulars which we are able to give of this exhibit are far too meagre to do it justice. But the Usines Bouhey did not see fit to accord our representative either the means of illustrating their machines, or even of examining them with care. In this the Usines Bouhey were unlike any other exhibitors. In all other cases attention and consideration were given to the wishes of our representative, and not only was he invited to examine for himself, but the features of particular interest were pointed out to him, and in more than one case the machinery was put in motion especially that he might be able to form a better opinion of its value. Correspondence with the firm has had no more satisfactory result than a personal visit, and we are obliged to fall back on the official descriptions and such notes as could be made without violating the dignity and independence of the Usines Bouhey.

The exhibit included vertical and horizontal milling machines; horizontal lathes, *tour en l'air a plateau horizontal*, as they are called in French; a vertical planing and slotting machine; drilling machines and gear-cutting machines. Of the last named there were two shown, one for straight the other for bevel teeth. The former is also adapted to cut helical teeth and to hob worm wheels, whilst the latter will cut helical as well as straight bevel teeth. In the gear-cutting machine the blank is placed horizontally, and the teeth are formed by a milling cutter working vertically. The division or widening takes place automatically, and the tool has a rapid return motion. The machine shown would take a blank 1·300 m. diameter (about 4ft. 3in.) and the vertical travel of the tool was as much is 18in., so that generally several wheels could be operated on at once. To cut helical teeth the tool carriage is inclined to the right angle, and the blank is given a slow movement of rotation by a train of change wheels and worm gearing. For cutting worm gear the milling cutter is replaced by a suitable hob, and the rotation of the blank is given in the same manner as for helical gear cutting.

The bevel gear cutting machine consists of a base on which a plate with automatic movement carrying the tool-box, pivoted and adjustable in two directions at right angles, is fitted. Two sectors joined by their axes are placed one at each side of the base. The front sector

carries all the gear for operating the cut; the other is arranged to effect the indexing automatically. The blank is fixed on a mandril mounted in a spindle turning in two bearings. This spindle has three motions—(1) a rotary intermittent motion for the division; (2) a circular motion in a vertical plane, of which the centre of oscillation is at the axis of the sector which imparts the feed; (3) a circular motion for giving the tooth the correct shape. For this purpose on the spindle carrying the blank is fitted a sector, on which is fixed a template on

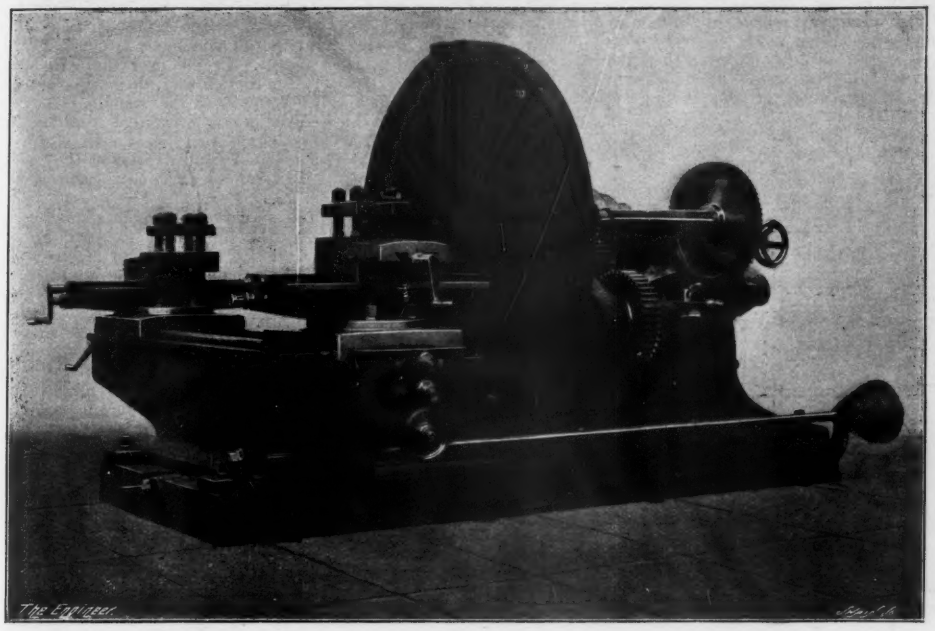


Fig. 5—BREAK LATHE—ATELIERS DEMOOR

an enlarged scale, which is always pressed against a fixed knife edge by a weight. These motions take part also in helical bevel gear cutting, but are supplemented by an alternating rotary motion of the blank proportional to the desired angle of the tooth. Motion is given to the template by the reciprocation of the knife edge, which is driven by a connecting-rod and crank. The knife edge moves in a guide curved to a calculated arc in such a manner that the point of contact of the template with the knife edge is always the same in the arc of oscillation described by the sector which carries the template.

The other machines exhibited were:—

A horizontal milling machine. It has a vertical movement of 1·400 m. (55in.) of the cutter, and equal motions in two directions of the table, each amounting to about 5ft. (1·550 m.); it is therefore a very large tool. All the levers for operating it are brought close together, and interlocking gear is fitted to prevent any accident. The direction in which the levers are moved corresponds with the direction of travel of the tables—a point well worth noticing. The tool carriage is counterbalanced by a weight inside the column, and can be raised or lowered by hand or power; the spindle runs in adjustable conical bronze bearings. The table is self-acting longitudinally, transversely, and circularly.

A vertical milling machine. The vertical travel of the cutter is about 14in., the longitudinal travel of the table 30in., and its transverse travel 43in. The tool carriage, besides vertical adjustment by hand, has automatic movement at different speeds. The spindle is carried in adjustable conical bronze bearings, the upper bearing having a thrust ring to take the pressure on the tool. Rotation is imparted by a five-step cone and double back gear. The table is circular, and is flanked by two rectangular tables. Self-acting movements are given to the table by friction discs. The usual arrangements are made for executing copy work, and a small centrifugal pump supplies lubricant to the tool.

The table of the horizontal lathe, mentioned above, is nearly 10ft. in diameter, and the greatest diameter which can be turned is some 2ft. 6in. greater. The maximum height of work which can be turned is about 6ft., and the greatest vertical or inclined motion of the tool bars is nearly 4ft. Also a similar lathe with 5ft. table, and another of about half the size, driven by a motor attached to it were also shown. A 12in. screw-cutting lathe, in which the lead screw is placed between the shears.

A vertical planing or slotting machine. The maximum stroke of the tool is about 5ft. 9in., its distance from the column over 4ft. The table is circular, its diameter is nearly 5ft., and it is mounted on cross slides, with a longitudinal motion of 51in. and a transverse motion of nearly 40in. The tool carriage is counterbalanced by a weight hung inside the column, and its stroke is regulated by tappets which move the belts on pulleys of different diameters for cutting and quick return. They drive a worm wheel which carries on its shaft a pinion driving a large intermediate spur wheel, which in turn drives a rack fastened to

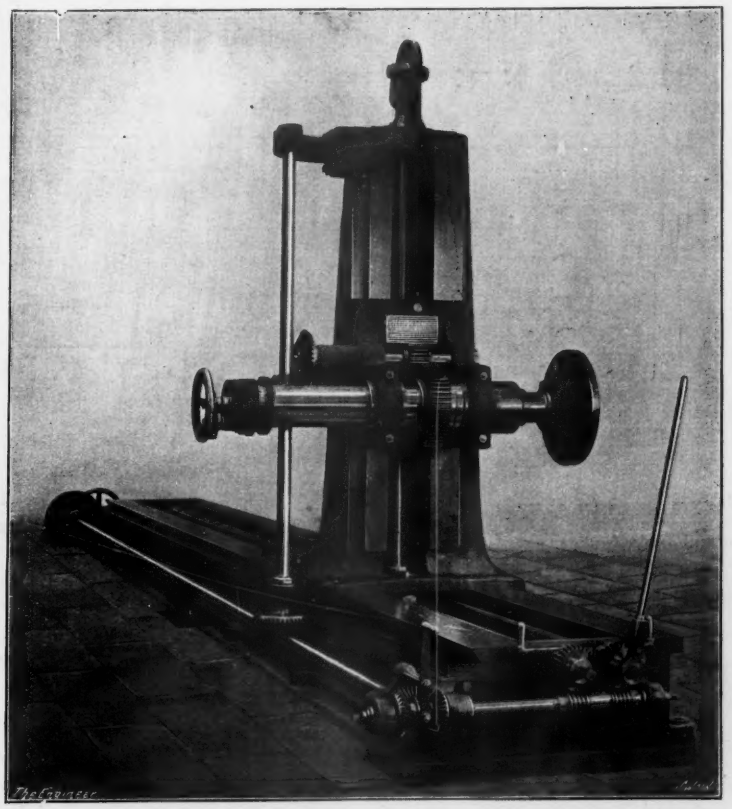


Fig. 6—VERTICAL MILLING MACHINE—ATELIERS DEMOOR

the tool carriage. The rack and pinion driving it are both double, and have cut teeth. The worm has thrust rings at each end, and works in an oil bath; it and the worm wheel are completely enclosed.

A slotting machine, stroke of tool 2ft. 6in., which has a double table. The lower table has motions at right angles. On it is mounted a second pair of tables controlled by a worm, and with a circular table on top of all. The piece to be machined is fixed to the latter and can be centred for cutting curves by the two upper tables, adjustment being made for different radiuses without dismounting the piece. To regulate the cut the lower tables are brought into operation. In this machine the usual connecting-rod and adjustable crank give the stroke.

A planing machine. Maximum length of work about 8ft., greatest width rather over 4ft., greatest height 3ft. 8½in. The tool is in appearance similar to the modern planing machine with two heads. The table is driven in the same manner as the tool carriage of the big slotting machine described above.

A shaping machine and three drilling machines completed the exhibit. The first-named calls for no particular mention, and the radial drilling machine is of the usual type. One of the other drilling machines has a double-jointed arm, giving a total distance of the tool from the column of nearly 12ft. The driving cone is placed on the top of the column, and drives the spindle by means of a belt and bevel wheels. The arm can thus describe a complete circle. The feed is either by hand or by power. The other drilling machine is also of the column type. It will drill holes up to 3½in. diameter, and has quick reverse for tapping by means of crossed belts. The spindle is brought down to its work by counterbalanced lever and chain, and is then fed automatically, throwing itself out of gear and rising when a fixed depth has been reached. The table can be raised or lowered by a screw and ratchet, and can swing round the column.

GANZ ET CIE., BUDAPESTH.

We have already, in past numbers of THE ENGINEER, dealt with the principal exhibits of Ganz et Cie., of Budapest, but a word or two about the little machine illustrated below, Fig. 7, will not be out of place. This machine is intended for cutting female screw threads. It is a portable

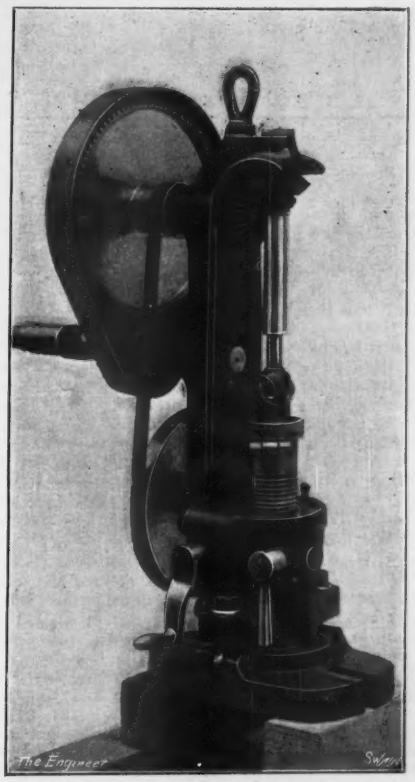


Fig. 7—MACHINE FOR MILLING SCREW THREADS

device, which can be bolted to the work on which it is desired to operate, and is driven by flexible shafting, coupled to a motor on a portable stand. The cutting tool is a mill with three rows of teeth. It is smaller in diameter than the hole in which it works, so that it attacks different points successively. It is fixed excentrically in a spindle, surrounded by a sleeve. This sleeve is screwed on the outside at the same pitch as the screw to be cut. It is revolved slowly, with the effect of causing the tool to touch the hole successively at all points and to rise slowly, thus cutting a thread. To allow of this combined excentric and vertical movement two universal joints and a telescopic rod are employed, as seen in the engraving. For cutting threads of different pitches suitable sleeves and cutters are provided. Several other portable electrically-driven tools were shown by this firm.

SOCIÉTÉ ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES, BELFORT.

In the French Section the two most interesting machines exhibited by the Société Alsacienne were a big drilling machine and a vertical milling machine. In the former, American influence was again very noticeable in the pattern of the standard. The drill is driven by a motor of 3·5 horse-power, stowed comfortably between the rear and forward columns. It drives by means of a *courroie à coin*, a belt nearly as deep as it is broad, and with tapered sides, which fits pulleys with truncated V grooves. The first shaft through helical gearing drives a two-step cone, which transmits by an ordinary belt to the cone at the top of the machine, and a pair of bevel wheels drives the drill spindle. A differential gear is fitted in the interior of the uppermost pair of belt pulleys. The result of the whole combination is a range of sixteen drilling speeds between 152 and 475 revolutions per minute. The front column has a slide for a drill carriage which can be set at any desirable height

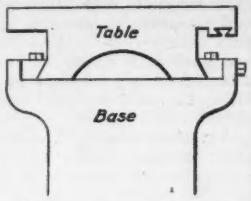
A counterbalanced sleeve with a rack cut in it slides through this carriage, and can be raised or lowered quickly by a hand wheel. The drill spindle passes through this sleeve and rises and falls with it. The whole carriage can be raised by gearing meshing with a rack cut in the middle of the sliding face on the column. The table has compound movements, and can be swung round quite out of the way when necessary. A hole is drilled in its centre for receiving the end of the spindle when boring or rimering. The largest hole which can be pierced on this machine is 4in., and the vertical stroke of the drill is 16in. at a maximum.

The vertical miller is a substantially-built machine of the type common in locomotive works in this country. It is driven by a 5 horse-power motor, bolted on to a bracket rather more than half way up the column. The sliding carriage for the lower end of the spindle is counterbalanced by a weight inside the column, and can be raised or lowered by a large hand wheel. The lower end of the spindle is conical, and turns in a bronze bush. Its upper end passes through a bevel wheel enclosed in the head of the machine, and running in a bearing which is part of the casting. The drive takes place through a pair of five-step cones with wedge belts, a reducing spur gear pair, a differential gear placed in a drum on the transverse spindle, and the bevel gear on the vertical spindle. It is thus practically the same as the gearing of the drill, only on a larger scale. The table has longitudinal and transverse movements, and is actuated by a vertical spindle inside the column, and a set of change gears. All the handles for working it are brought to the front of the machine, and are quite accessible. An additional table with circular motion can be attached when desired. It is flanked on each side by a narrow rectangular table. Automatic knock-outs are fitted to all the self-acting motions. A lubricating pump is also included. A number of other smaller machines were exhibited by this firm, and are all substantially and carefully designed.

Several large and many small machines were exhibited by the Société Alsacienne de Constructions Mecanique in the German Section. Among the former was a cylinder boring machine, which occupies a space 19 m. by 3½ m. in area. It has been designed with a view to simplifying the adjustment of the cylinder to be bored, by providing a ready means of withdrawing the boring bar. The machine consists of a long bed-plate, part of which—about half—is provided with ⊥ slots for mounting the work. At one end of the bed is an outboard bearing, and in the centre the driving head through which the boring bar passes, its end being supported in a carriage, which slides along a bed raised above, but carried by the extension of the bed behind the head. The diameter of the boring bar is 14in.; it is of forged steel, and carries a wheel or disc chuck adapted for several cutting tools, which can be firmly fixed to the bar at any desired point; the bar can be left free in the tail carriage or gripped by it at any point, to be pulled backwards or forwards by power. Ten different speeds of rotation can be given to the bar. The maximum diameter which can be bored is about 85in., and the greatest length some 10ft.

Another large tool is a vertical milling machine, roughly similar in design to that exhibited by Demoor, illustrated on page iii. Fig. 6. This type of machine is generally used in combination with a cylinder-boring machine, and provides the means for machining various flat surfaces, the valve chest, the feet, &c., at the same time that the cylinder is being bored. Or it can be used for the machining of any large surfaces, taking the place of the planing machine for certain classes of work. The bed-plate is heavy, and has broad flat shears, and the vertical column is also of ample proportions. The spindle head is counter-balanced and raised or lowered by power. The machine is self-acting throughout, and automatic knock-outs are provided for feeds in all directions. The spindle can be inclined at an angle of 30 deg. above or below the horizontal; it has a variable longitudinal movement and a quick return. The maximum height of the spindle above the base is 3·35 m. (say, 12ft.), the total vertical movement about 8ft., and the total travel along the base some 11ft., from which it will be understood that the machine is of large proportions. It is driven by electricity.

A large horizontal milling machine was also shown. It is of the planing machine type, the table travelling with the work between fixed columns. The table is not mounted in a way to which we are accustomed in this country. It travels on flat shears on the top of the base, and is kept down, not by external vees on the sides of the shears, but by vee strips screwed to the top of the shears and gripping the sides of the table, thus:—



This machine is also electrically driven. The power is transmitted through a pair of five-step cones and a train of gearing, the final pair being a large spur wheel on the milling spindle. The table travels automatically or by hand, and its speed is variable by friction gearing. There is no provision for using vertical cutters. The total travel of the table is about 11ft., the distance between the uprights about 2ft. 10in., and the maximum height of the centre of the milling spindle from the table, 36in.

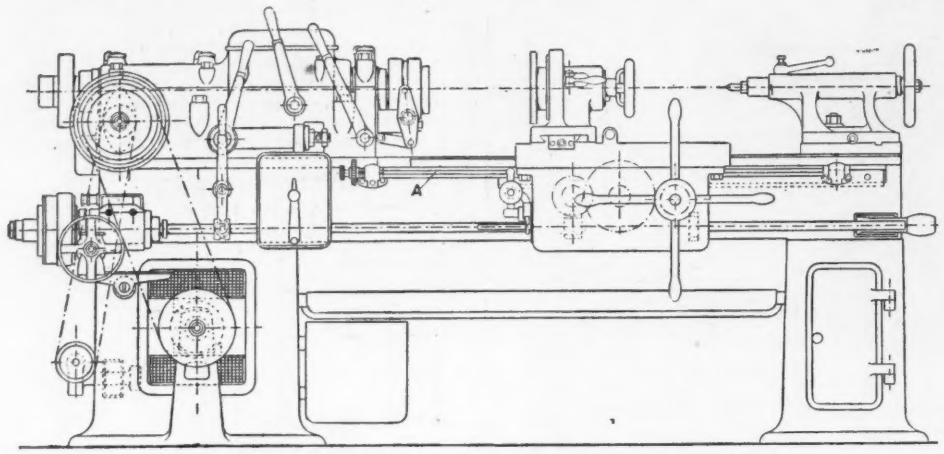


Fig. 8—VERTICAL TURRET LATHE—SOCIETE ALSACIENNE—MULHOUSE

The *Tourneuse* is a convenient name applied in French to the horizontal lathe. One of these with a table 3ft. in diameter was exhibited by the Société Alsacienne. It is electrically driven. A turret head carrying four tools is mounted on the cross slide. The design is very substantial, and, as in all other tools made by this firm, the running gear is entirely boxed in. Two lathes are also shown, both electrically driven by motors fixed in the base under the headstock. The entire boxing in of the gear gives both lathes a very remarkable appearance. The smaller machine is a semi-automatic, with a vertical turret carrying four tools of the circular type; the larger is a facing lathe designed with great regard for strength. It is driven by a continuous-current motor of 6·5 horse-power at 220 volts. The spindle is hollow, and carries a large concentric chuck. A prolongation of the bed supports a differential gear actuated magnetically. The motion is transmitted to the spindle by two five-step cones, reducing gear, with

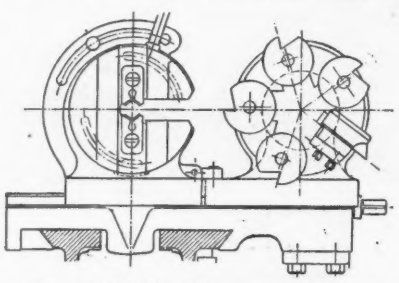


Fig. 10—VERTICAL TURRET AND TOOLS

or without a differential gear coupled magnetically, and by one of three pairs of spur gearing, of which the wheels are mounted free on the hollow main spindle, and coupled to it by friction as desired. Thirty different speeds can be given to the face-plate. The turret has provision for taking seven tools, and is mounted on the top of a compound slide-rest. Self-acting and knock-out motions are fitted throughout. The height of centres in this remarkable lathe is 16in., and the total length nearly 19ft.

A general view of the smaller lathe is given in Fig. 8, and a section through the headstock in Fig. 9. The latter is specially interesting. The motor drives the shaft A, on which is a worm driving a worm wheel loose on its shaft, but carrying a drum enclosing a differential gear. One member of the gear is keyed to the shaft, and according as the friction clutch B is bearing to the right or left, the shaft runs at the speed of the worm wheel or at a reduced speed. At C is shown the lever which moves the clutch. It has an enlarged counterpart exterior to the casing. The spindle carries two pinions of different diameters, meshing with two wheels on the lathe spindle, both of which are free, but either of which can be coupled to the spindle by a friction gear. In this gear the little levers D D are fastened in the friction ring, their tails entering a groove in a collar screwed to the spindle. They are rocked to right or left by a ring E, worked from the outside, and from their shape they remain in whichever position they are put. In a central position they transmit no motion. Speaking of this pretty arrangement in the *Zeitschrift*, Herr Hermann Fischer says:—"It permits of powerful gearing being fitted into small space, provides the workman with protection against the gearing, and the gearing against dirt, and allows of effective lubrication of the enclosed gear. I believe that it will receive general approval." The gearing gives four changes of speed and the belt four, or a total of sixteen changes ranging from twelve revolutions per minute up to 285. The gearing is so arranged that suitable speeds for turning, facing, polishing, and screw cutting any one piece can be obtained without shifting the belt. The feed shaft is placed rather low down on the bed, and is driven by a belt from the end of the main spindle. Three different speeds can be given to it by the movement of a lever. The shaft marked A in the general view Fig. 8 is cruciform in section, and carries four independent stops. The feed shaft drives gearing inside the apron, which acts on a fixed rack in the usual manner. A worm is included in this gearing, and is held up in place by a catch which is touched by the stops on the cruciform bar, allowing the worm to fall down out of gear at any desired point. The cruciform bar is revolved by hand. The cross slide is shown in Fig. 10. It has also four independent stops on its self-acting motion. A screwing gear is attached to it. The sketch explains it fully.

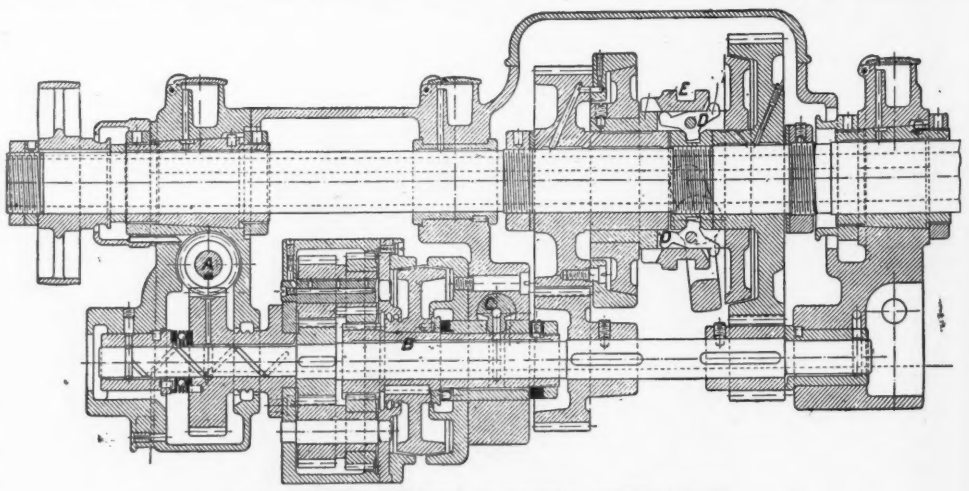


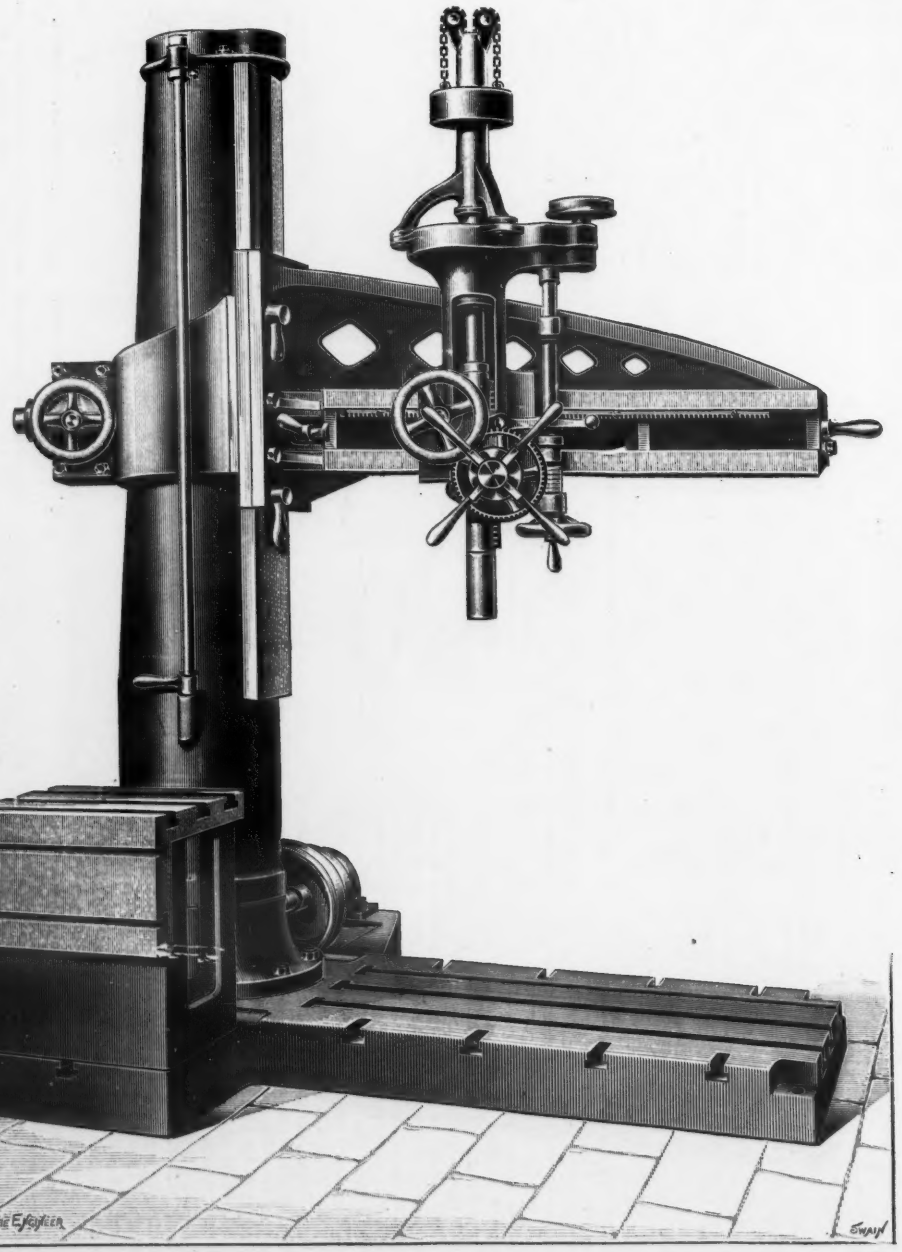
Fig. 9—HEADSTOCK GEARING OF VERTICAL TURRET LATHE

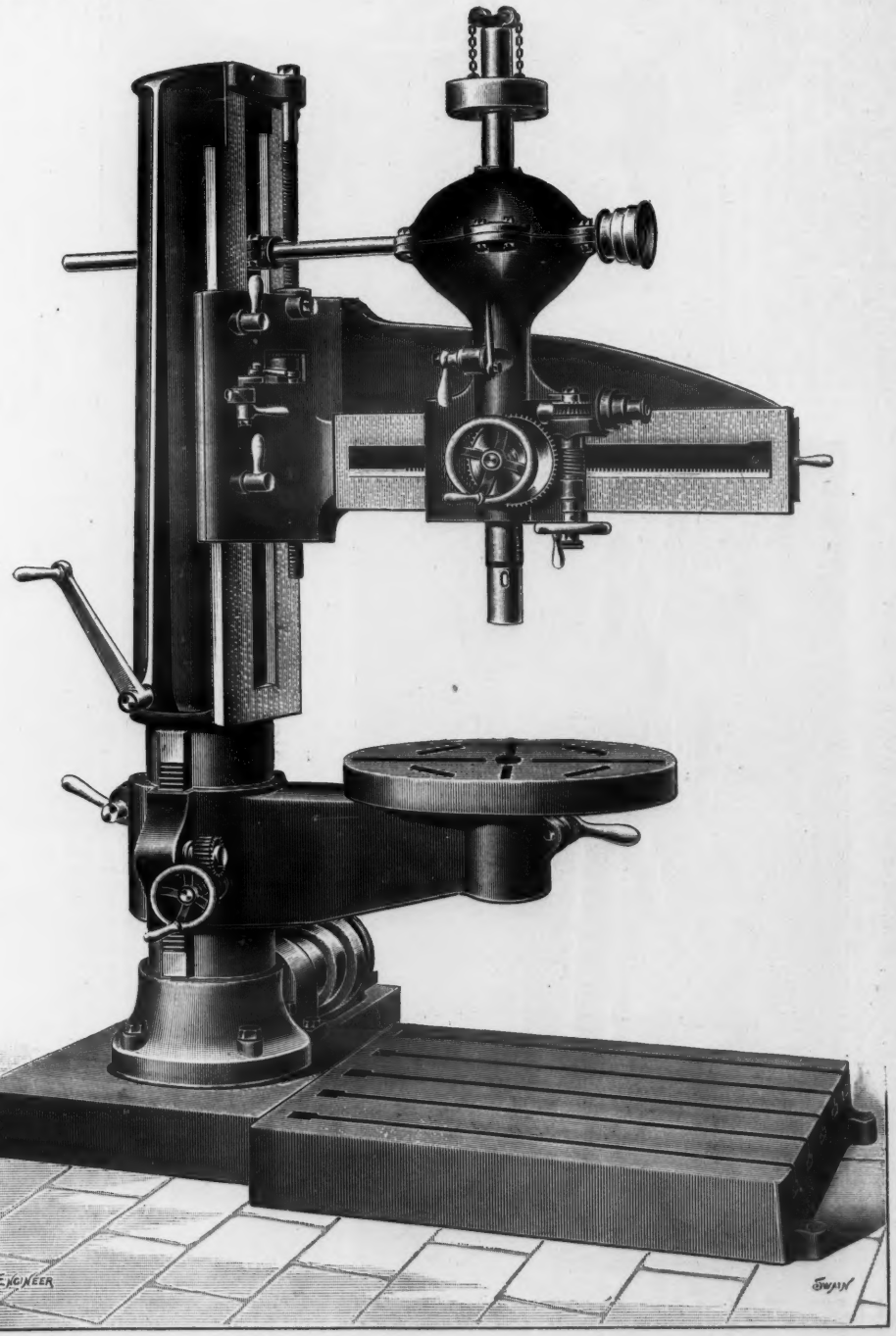
AUX FORGES DE VULCAIN, PARIS.

Two drilling machines made and exhibited by Emile Chouanard, Aux Forges de Vulcain, Paris, are illustrated on page v. In spite of the assertion of the maker that the machines are of a *construction irreprochable et robuste*, we imagine that British tool makers will take exception to the form of the column in both cases. In neither design does it appear sufficiently rigid for the size of the machine, although the second type at any rate follows closely an American pattern. In the first, for example, the diameter of the base appears very small for a machine which takes drills up to 2·4in. diameter, and in the second, taking drills up 3·2in., the whole column is far less substantial than the widely-used box section standard. It is difficult to see the object of the peculiar design shown in the first. The upper part of the column rotates round the inner cylindrical part. We have no figures as to how far the cylinder projects into the apper part, but from the fact that the horizontal spindle passes through the column it is fair to assume that it extends little more than half way up. Why the end of the radial arm was not made to embrace a plain cylindrical column we are unable to say. The machine, it will be seen, is not inconveniently arranged, and the method of enclosing the gear is neat if unusual. Means are provided for readily locking the radial arm both for height and position, and for raising and fixing the table. Eight different cutting speeds can be given to the spindle, and a reversing gear is provided for tapping. The second illustration shows a larger machine, drilling holes up 3¼in. in diameter. The whole column revolves with the arm, and is mounted on friction rollers. Special means are provided for clamping the arm at any height. The machine can be operated entirely by the levers on the carriage. Friction gear is employed, and the spindle has a rapid reverse. The drill spindle is graduated, and there is an automatic knock-out. The speed is altered rapidly by the simple movement of a lever. All nuts in frequent use are provided with fixed levers, obviating the use of spanners—a point which some

PARIS EXHIBITION—RADIAL DRILLING MACHINES

MONSIEUR EMILE CHOUANARD, AUX FORGES DE VULCAIN, PARIS, ENGINEER





12IN. GAP LATHE

HERR J. E. REINECKER, GABLENZ-CHEMNITZ, SAXONY ENGINEER

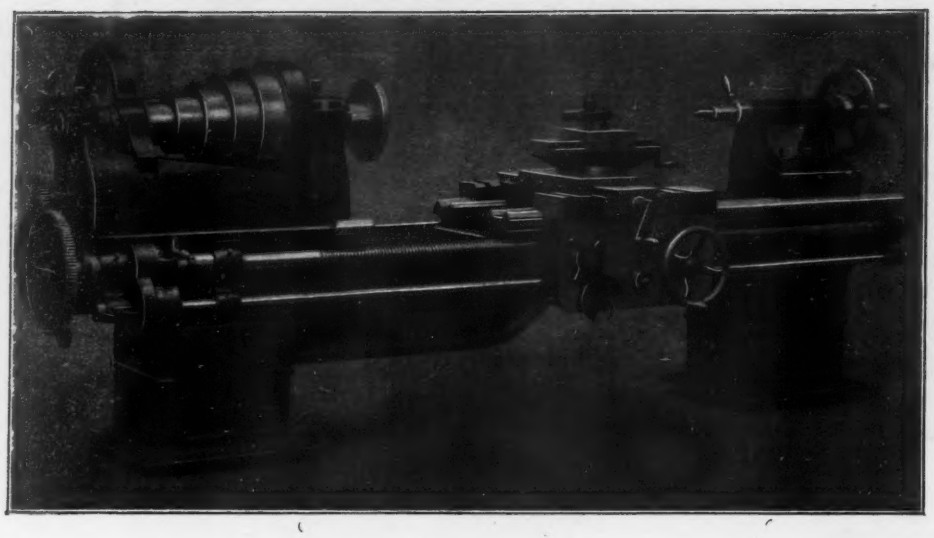


Fig. 11—SCREW CUTTING LATHE

British makers would do well to observe. It will be seen that there are excellent points about both machines, although the general designs do not seem to us all that could be desired.

J. E. REINECKER, GABLENZ-CHEMNITZ.

One of the principal exhibits in the German Section was that of Herr J. E. Reinecker, of Chemnitz-Gablenz, Saxony. Herr Reinecker's works were founded in the year 1859. At the present time 1150 persons are employed, and machine tools of all kinds, but principally those of moderate sizes, are constructed. We have selected several of their machines for illustration as the best representatives of German work in this class of tools. Fig. 11 shows a screw-cutting lathe in which the effect of American influence is not far to seek. Indeed, Herr Reinecker admits that he has followed American models closely in his lathes, only modifying them to suit German conditions. The American type of carriage has been adopted, it is stated, because the bed is less easily damaged by dirt and shavings than in the older form, because defects are more readily discovered, and, furthermore, because it maintains its accuracy better. The headstock is of exceptionally strong design; the spindle is hollow, of cast steel hardened at its bearings. The front bearing is taper, and is provided with a hard steel taper ring—see the section, Fig. 12—ground to fit. The back bearing is parallel, but has a conical adjustment ring. The end thrust is taken on a ball bearing. Special care has been devoted to the arrangement of the change wheels, and a special multiplying gear is shown in the drawing. The lead screw is made exceptionally big, and is used only for screw cutting. A special feed shaft actuates all the other motions, and it is impossible to put the lead nut in whilst this feed shaft is in action. The self-acting gear is thrown in either for traverse or longitudinal travel by turn-pins on the saddle. The back centre is of special design in the machine illustrated, being thrown towards the back to allow the tool slide to pass it. The particular lathe shown has centres 300 mm. (say, 12in.) high, and is provided with a gap. The drawing and engraving bring out the points most worthy of note.

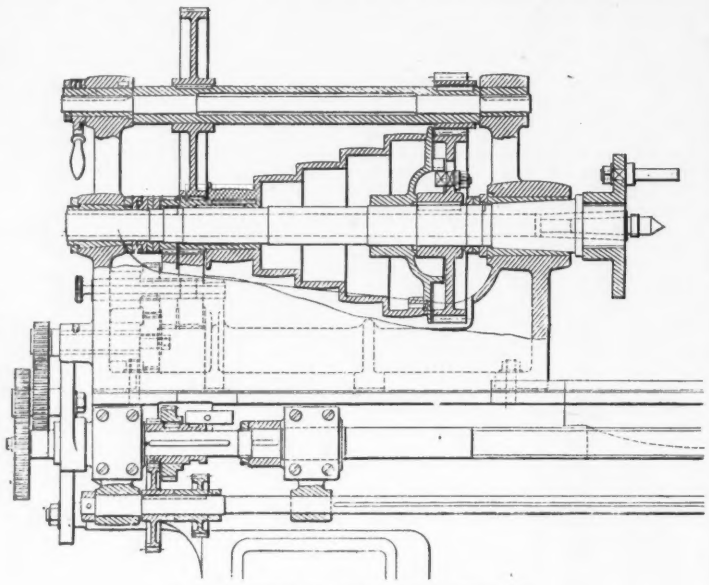


Fig. 12—SECTION OF HEADSTOCK—REINECKER

Herr Reinecker has devoted considerable attention to worm gear cutting, and exhibited several machines for the purpose. He points out in the excellent descriptive catalogue of his exhibits that the disrepute and disadvantages of worm gearing are due to constructive defects, and are not inherent in the system. Incorrect machining results in contact taking place at only a limited number of points, instead of all over the surface of the teeth, which results in an increase of pressure sufficient to destroy lubrication and to produce rapid wear. The machine which is the subject of Fig. 13 has been designed to produce a very accurate worm wheel. The main point to be observed is the hob or cutter. An enlarged view of this is given in Fig. 14. It is, it will be observed, steeply tapered at one end. This is for the purpose of the feed which is produced by moving the hob longitudinally. The machine illustrated will take wheels up to 2ft. 6in. diameter, and will cut worm wheels with a skew of 20 deg. right or left. Provision is made for setting the axis of the tool at the right distance from the centre of the work with great accuracy, the rest depends upon the cutters, which are produced on the relieving lathe described below. To fit it for cutting a variety of diameters a set of worm wheels is provided, one of suitable proportions being selected and keyed to the end of the main spindle. The worm for driving it is mounted in a carriage adjustable vertically; another variable train gives the right speed of rotation and advance to the hob. The engraving exhibits the arrangement very fairly, and a cross section of the table is given in Fig. 15. Two or three different patterns of machines, all on the same lines, are made.

In connection with this worm wheel machine it is interesting to note that a machine for producing worms more accurately and cheaply than they can be made on the lathe was exhibited by Herr Reinecker. The worm is mounted on a mandril between two heads, and is cut by a milling cutter keyed to a spindle, driven by a small worm pair. The work is fixed, except that it revolves at the desired speed, the cutter travelling along it.

One of the most interesting, because exceptional, machines on this stand was the backing-off lathe, illustrated in Fig. 17. We cannot say if any makers in this country have yet turned their attention to this type of tool. It is certainly not a well-known type, and a word or two about its uses will not be out of place. Its introduction, like so much else in machine tool invention, is due to the increased and increasing use of milling cutters. These tools—we mean the actual cutters—are often difficult to make, always expensive to buy, and frequently late in arriving when ordered from makers or merchants. The backing-off lathe has herefore been brought out to enable the manufacturer to construct his own milling cutters, and to be free, at any rate in a measure, of the tool merchant. In the construction of all cutters the production of the form desired is generally the least difficult operation. In the majority of cases it is simply a matter of turning in a plain or in a copying lathe. With the fact that subsequent deformation in the process of hardening may occur we are not now concerned. The nicking of the disc to form the teeth is also not a difficult matter, and it is not till the backing off, so essential to clean cutting and endurance of the tool is attempted, that obstacles arise. We may take the case of a simple cutter, such as that shown in Fig. 16. To get good results from such a tool it is necessary that the cutting face be bigger than the rear face that is to say, that clearance both on top and at the sides must be provided. The object of this machine is to cut that clearance. The lathe, as a lathe, for which purpose it can be used when desired, calls for little comment. In design, excellence of workmanship and finish, it leaves nothing to be desired. Most of its points can be gathered from the engraving. It is, it will be seen, electrically driven, and is provided with a foot brake for stopping. The interest centres in the slide rest. By an arrangement which is shown in Fig. 18, the cross slide is given a rapid reciprocating action. Referring once more to Fig. 16, this reciprocating motion carries the tool inwards towards the centre whilst cutting from point to heel, and then very quickly back to position for the top of the next tooth. The carriage is travelling, as a whole, at the same time, and so the tops of the cutting teeth are backed off. By slewing the carriage round in a way that will presently be described, the sides of the tool can also be backed off.

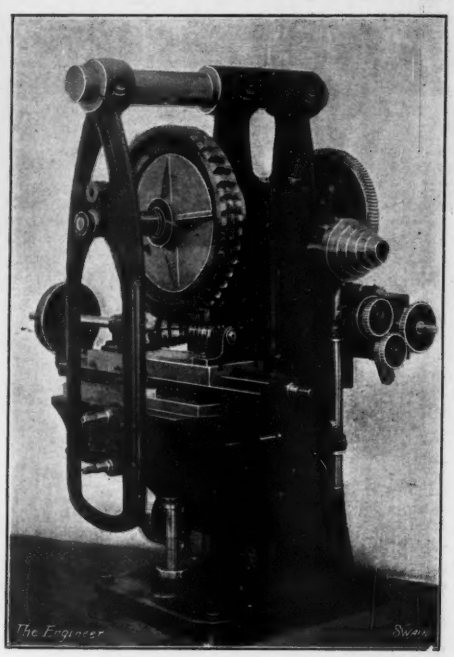


Fig. 13—WORM WHEEL HOBBING MACHINE

Fig. 14—HOB

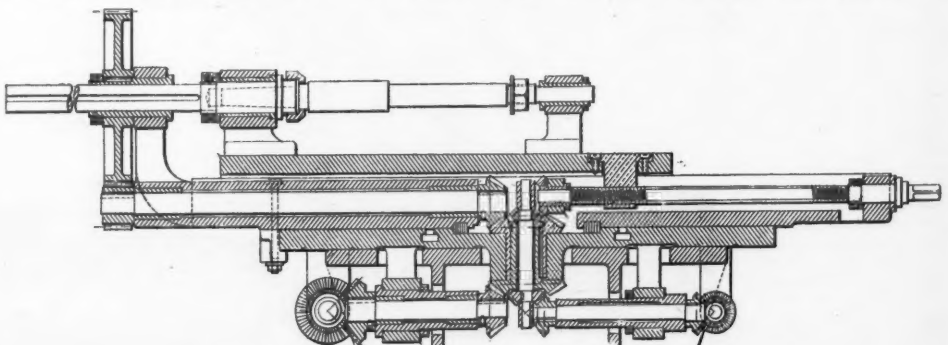


Fig. 15—TABLE OF WORM WHEEL HOBBING MACHINE—REINECKER

In the centre of the lathe bed there are two shafts E and K—Fig. 18. The former is coupled to the driving cone through a train of wheels, and it in turn drives K through another train, which will require further explanation. In K a long keyway is cut, by which the bevel wheel H is driven, and rotation imparted to a short vertical spindle in the centre of the saddle. On the top of this spindle is mounted a cam M, which acts against a roller fixed in the cross slide L, drawing it forwards to effect the cut, and releasing it, to be pulled back rapidly by a spring at the right moment. The slide L is mounted on a plate pivoted on the saddle, which can be swung round to any angle. As the cam is central with this pivot, the reciprocation of L still takes place at whatever angle it is placed. By this means the sides of a cutter can be backed off. Fig. 19 shows a plan of the rest, and may help to make the arrangement clearer.

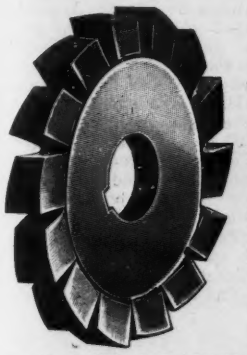


Fig. 16—BACKED-OFF CUTTER

It is evident from what has preceded that the cam must make one revolution for each tooth on the cutter to be backed off. The object of the gearing—shown in Fig. 18—is to provide this motion. But its complexity is due to the fact that the lathe illustrated is applicable to a great variety of work, and in machines destined only for plain backing off it is far simpler. The lathe we are describing can not only be used for ordinary lathe work, and relieving or backing off cutters with straight sides or grooves, but it can be employed for relieving worm hobs of any twist, right or left-handed—see for example Fig. 14—or for producing and backing off shaped cutters with straight or helical grooves. It is thus very appropriately termed a universal relieving lathe. A short explanation of the principal mechanism may be welcome to some of our readers.

The shaft E receives its motion from a train of wheels under the poppet head, and carries it to a differential gear of four members. The wheel O of this group can be held by a worm and worm wheel, and if it is stopped entirely the pair of wheels mounted on the cross end of the shaft N causes this shaft to revolve at half the speed of the shaft E. On N is keyed a wheel P, which through a variable train drives K at a fixed proportionate speed to the headstock spindle, and is therefore available for plain backing off. For spiral relieving the lead screw has to be employed also to give the slide the correct rate of travel. Looking at the engraving, Fig. 17, it will be noticed that the lead screw carries at its right-hand end a spur wheel. This wheel through another variable train drives the worm on the bevel wheel O of the differential gear. The result is that P revolves faster or slower, according to which way O is revolving and its speed of rotation, and P transmits its motion through its own train as before to the cam shaft. But as the lead screw now shares the control the desired effect is produced. For copying work a special slide is used instead of that shown, the copy being fastened to the back of the lathe bed. It may be observed that a split nut is used for the lead screw.

Another useful machine shown by Herr Reinecker was a twist drill milling machine, which cut the two channels simultaneously. It consists of a T-shaped bed. On the longer limb slides a carriage with the stock, and provided with requisite gearing for revolving it. On each branch of the cross-piece of the T is mounted a poppet head with a three-step cone, which through a short train of gearing drives a milling cutter, which can be inclined to any desired angle. Of course the two cutters are inclined by equal amounts, but in opposite direction, as they cut on points diametrically opposed on the stock. It is claimed that by cutting both channels at once in this way strains are not produced in the drill as they are when drills are made in an ordinary universal milling machine. These machines are also employed for backing off the flank of the spiral, which is coming daily to be considered essential to good and economical work. This is rather a toolmaker's than a general engineer's machine, for we imagine that few of the latter could find sufficient occupation for it to make it pay.

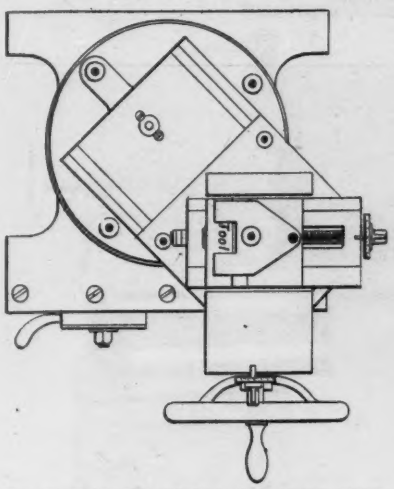


Fig. 19—PLAN OF SADDLE AND SLIDE REST

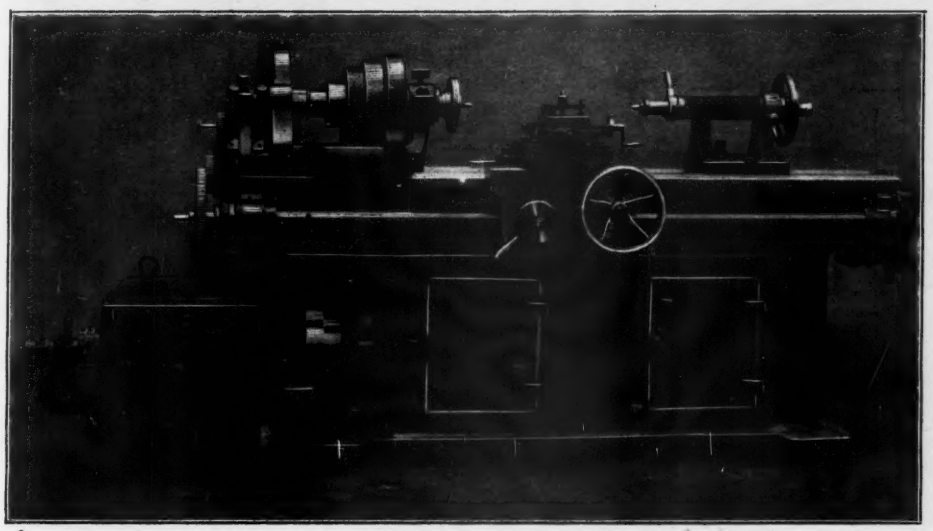


Fig. 17—BACKING-OFF LATHE—REINECKER

Herr Reinecker makes a very great variety of milling machines, and if space permitted, it would be interesting to illustrate several of them, and to contrast them with American and British practice. This it is impossible to do, and we must content ourselves by saying that in this as in other branches his work has reached the highest standard in machine tool construction, both in design and workmanship.

LUDWIG LOEWE AND CO., BERLIN.

It will be interesting to compare a backing-off lathe made by Ludwig Loewe and Co., of Berlin, with this the similar machine of Herr Reinecker's. Ludwig Loewe and Co. did not exhibit at Paris, but we have had an opportunity of examining this lathe in the company's show room in London and of seeing it at work there and in Berlin. An engraving of it appears on the next page. It resembles very closely an ordinary cabinet lathe, and can, indeed, be used for ordinary lathe work. It has a lead screw and feed shaft, a complete set of change wheels, and a taper attachment which can be used in conjunction with the relieving gear or not as desired. The spindle is of steel, and has hardened and ground journals running in bronze bearings ground to fit, and provided with means for taking up wear. This bearing consists of a bronze bush tapered externally, but with a parallel hole, and with four longitudinally exterior slots diametrically opposite each other, one of which entirely severs the metal. A screwed ring or nut fits each end of this bush, and provides means of adjusting the internal diameter of the bush by driving it further into its conical seat in the casting of the headstock. This method, of course, is not peculiar to Ludwig Loewe and Co.'s tools. It is largely used by other firms, and is found satisfactory. The belt feed, driven from an independent strap from the countershaft, gives six changes of feed, and is reversed by the usual gear in the apron. The headstock has a large ratio back gear, and is so arranged that the screw cutting can be done with the small cone gear, thus increasing the feed proportionately with the back gear, and making it possible to cut a very steep pitch. The manner of effecting this is as follows:—On the back end of the lathe spindle is fitted a pinion, inside the horns of the casting, and touching the back gear pinion on the cone pulley. Both pinions are covered by a guard, seen in the engraving. Immediately beneath them are two idler wheels loose on a fixed pin and gearing with them. Beneath these, again, the spindle of the screw-cutting pinion enters the headstock, and has a small wheel gearing with the idlers free to slide on it. The small lever shown in the engraving slides this wheel so that it receives motion either from the spindle of the lathe direct, which, of course, is revolving slowly when the lathe is in back gear, or from the cone pulley, which is travelling at a much higher speed. The actual ratio in the lathe under notice is 12 to 1. That is to say, if, with the lever in one position, twelve threads per inch were being cut, with it in the other position there would be only one thread per inch. This device is fitted to nearly all lathes made by this company. A very similar arrangement is shown in Figs. 12 and 18. The slide rest is a special design made extra stiff. It has screw adjustment by the hand wheel at its side for bringing the backing-off tool exactly to position. The hand wheel for traverse is very large. A simple device is attached to this slide, as to all those made by this firm, to facilitate screw cutting, and to do away with the wet thumb and lump of chalk of prehistoric origin. It consists simply of a small steel rod, screwed for about half its length, and fitting into a hole in the cross slide, where it can be clamped by a screw when in use. On the screwed part are two knurled nuts, one on each side of a fixed projection on the apron. To use this simple apparatus the two nuts are screwed up to within a short distance of the projection on each side. The outside nut is then adjusted till, when the traverse slide is as far forward as the nut will let it go, the tool is just

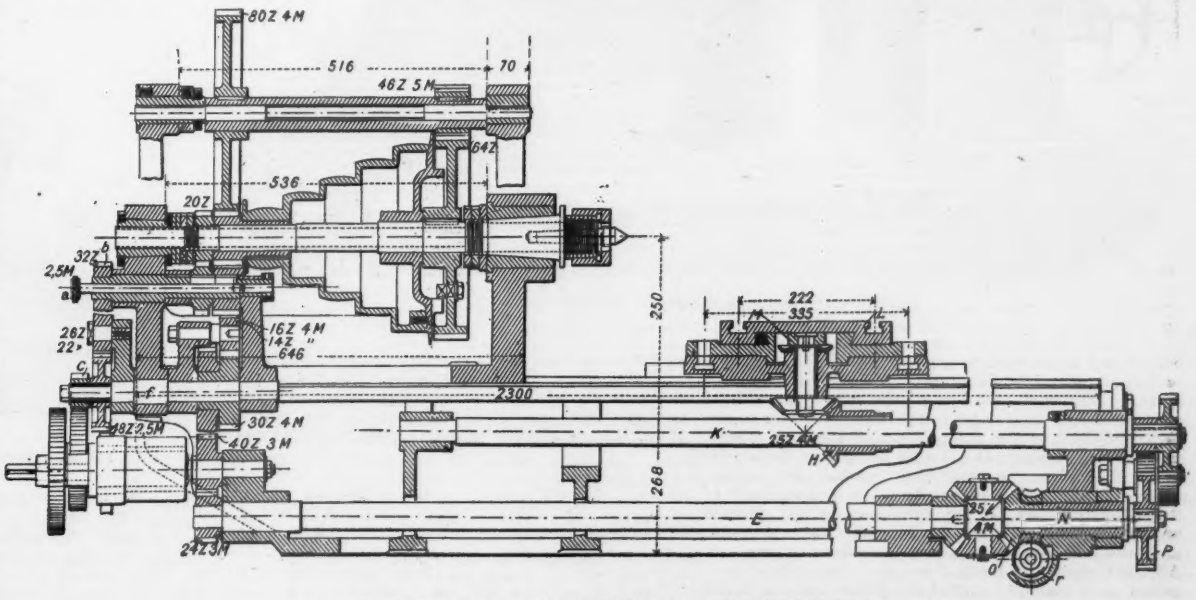
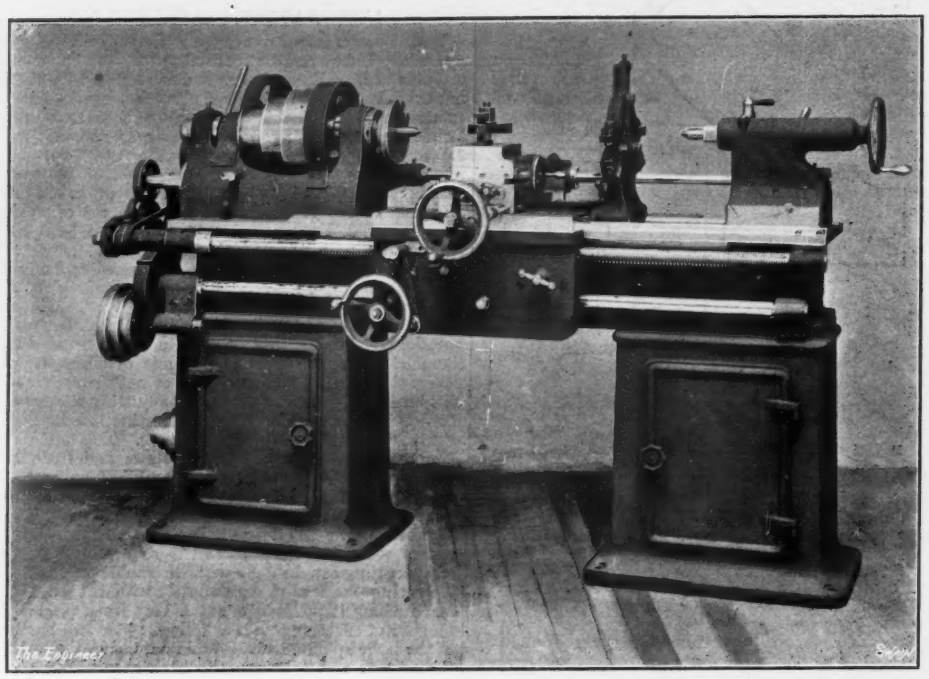


Fig. 18—BACKING-OFF LATHE—LONGITUDINAL SECTION—REINECKER

cutting. A cut is then taken, and when it has gone far enough, the hand wheel is turned rapidly till the slide is checked in its backward course by the second nut. The first nut is then given a turn backwards, and the tool takes a fresh cut, and so on. The device is very simple, works well, and would be quite worth fitting to many old lathes not provided with any gear for the same purpose.

BACKING OFF LATHE

LUDWIG LOEWE AND CO., BERLIN, ENGINEERS



In Herr Reinecker's machine a differential gear and worm wheel are employed for giving the correct speed of rotation to the back shaft. In the Loewe machine the same end has been attained by a very elegant mechanism, of which a description must be deferred till a future occasion.

The cam gear for giving the reciprocation to the tool is also different, and, we think, superior to that of Herr Reinecker. The cam spindle enters the saddle from behind, and is revolved by a pair of bevel pinions on the back shaft driven by the control gear. On this spindle is keyed the cam, which is of the face type, and resembles a one-way clutch. The other member of the clutch is fixed to the cross slide, and the cam spindle passes freely through it. A pair of springs keeps the cross slide always pushed back against two rubber stops. As the cam shaft revolves, the inclined teeth of the revolving part of the cam rise on the inclined teeth of the fixed part, driving the latter forward, and with it the cross slide, so producing the cut. At the instant the teeth disengage, the cross slide is pulled back instantly against the rubber washers, which reduce shock, and the tool clears the work. This gear does not interfere in any way with the use of the cross slide for ordinary use when desired.

It may perhaps be worth remarking that as the control gear is only needed when backing off worm hobs and spiral cutter, provision is made for clamping the saddle securely to the bed for plain backing off; the control gear is then, of course, out of action, as it is only effective when the saddle moves. This lathe is not fitted for side relieving, like Herr Reinecker's machine, but it is to be observed that for a great variety of cutters the action of relieving the tops has also the effect of relieving the sides. This is evidently the case with all cutters which have non-parallel sides. Take, for example, the cases below, which show the cutting faces full, and back faces dotted, the backing off being produced in each case by a suitably formed tool.

The teeth in this, as in all lathes made by Ludwig, Loewe and Co., are cut from the solid, and the general workmanship throughout is of a very high standard. A few dimensions may be acceptable. The height of the centres is 9in., giving a swing of 6¼in. diameter over the carriage. The greatest distance between the centres is 31½in. The spindle can be given eighteen different speeds,

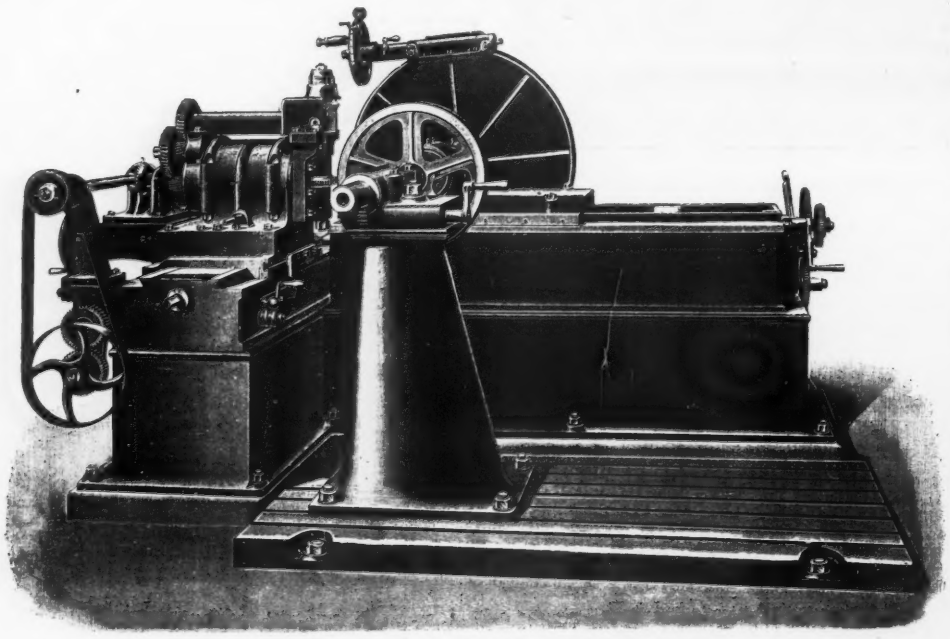
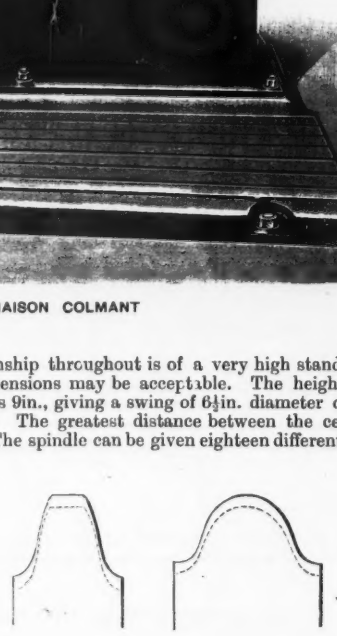


Fig. 20—GEAR CUTTING MACHINE—MAISON COLMANT



and cutters, having from three to twenty-six teeth, can be backed off, the revolutions per minute for this purpose being twenty-four.

A much smaller and simpler machine, working on the same lines, but for straight backing off, is also made by this company.

MAISON COLMANT, PARIS.

Although the Monneret gear cutter, to be described later, took the place of honour on the stand of the Maison Colmant in right of its novelty and importance, many others of the tools exhibited were well worth inspection.

Amongst these a large gear cutter for straight or helical teeth attracted our attention—Fig. 20. It consists of a solid box bed, L shaped in plan. On the longer limb is mounted a slide carrying a large dividing wheel and a mandril for the blank. On the shorter member is fitted in a very stiff and strong head a milling cutter. The cutter is carried on a spindle the bearings of which touch it on either side. It can be swung round to any angle up to 90 deg. for cutting helical and worm gearing. It travels and disengages automatically for the cut, but has to be returned by hand. The spindle is driven by helical gearing, and can be given eight different speeds between 20 and 125 revolutions per minute. It is of hardened steel carefully adjusted in its bearings. The spindle for the blank can be fitted with various forms of chucks, and its outer end if desired is supported by an outboard bearing on the top of a pedestal

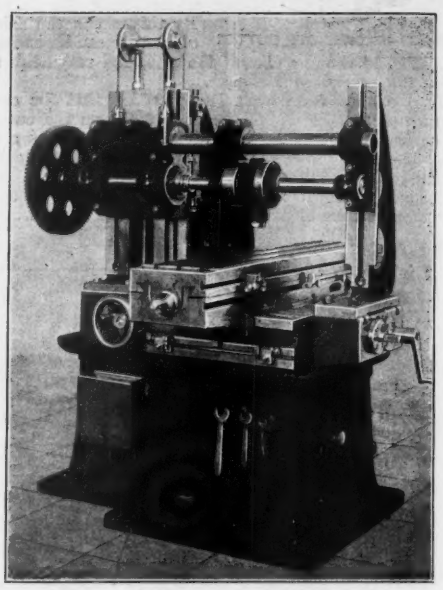


Fig. 21—HORIZONTAL MILLING MACHINE

clamped to a base with ⊥ slots. It has a sleeve which can be slid backwards and forwards by a rack, so that the whole pedestal need not be moved when it is desired to mount a new blank. The machine is supplied with a universal dividing attachment, which can be replaced by a notched indexing plate if many wheels of the same size are to be cut. The division is effected by a worm wheel of large diameter having 360 teeth. An index wheel on the worm has 1000 divisions, so that one division corresponds to $\frac{1}{360000}$ of a revolution of the blank. The worm is turned by hand after each tooth is cut. The machine is in no way automatic. For cutting helical and worm gear a second worm wheel is mounted on the spindle and driven by a suitable train of gearing. This fine machine cuts wheels up to 6ft. 6in. diameter. The total travel of the milling head is 24in., the maximum diameter of the cutter is

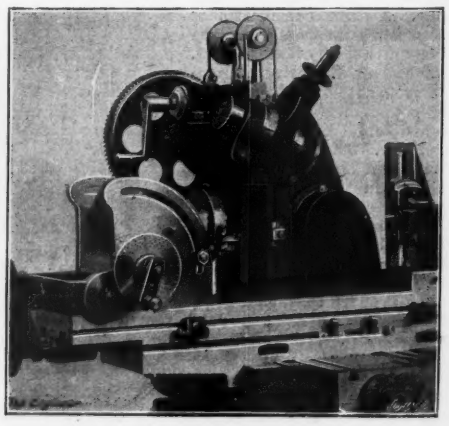


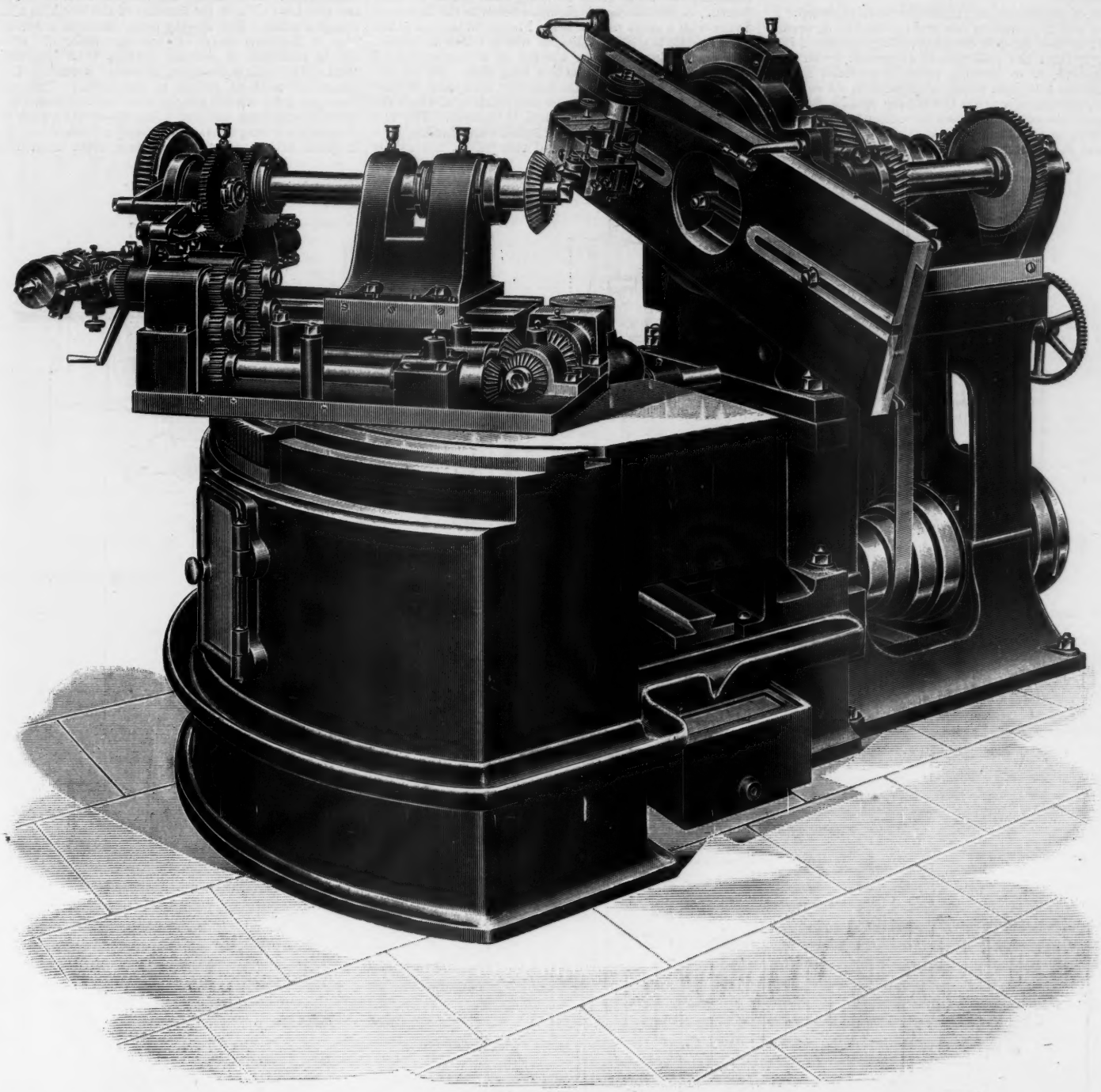
Fig. 22—UNIVERSAL MILLING MACHINE

7½in.; its speed of advances can be given fourteen variations. The slowest 0·13 mm., the highest 4·82 mm. per revolution. The driving cone has only two diameters, the larger 14in., the other 8·4in., and the width 4½in.

A very simple bevel wheel shaper is also made by the Maison Colmant, but was not exhibited. A short description of it may, however, be useful to those who are interested in this class of machinery. It is made in two sizes. It consists of a rectangular base of box section on the side of which, not the top, all the gearing is mounted. This gearing comprises:—A cutter slide carrying an adjustable tool box, and is given a horizontal reciprocating motion by connecting-rod and variable crank; a quadrant free to swing about a pivot under the centre of the slide; a spindle mounted on the quadrant, the axis of which

MONNERET BEVEL WHEEL CUTTING MACHINE

MAISON COLMANT, PARIS, ENGINEERS



passes through the axis of the quadrant at right angles; a worm and worm wheel mounted on this spindle, and a plate and vernier connected with the worm for dividing the wheel; a projection from the side of the spindle carrying a template, which is caused to bear against a fixed point by a cord and weight. In operation the blank is fixed on the end of the spindle, and brought into such a position that the apex of the generating cone coincides with the axis of the quadrant, and the quadrant is adjusted till the upper face of the blank is horizontal. The tool is then set to work, and at the same time a pawl and ratchet drive a worm which causes the quadrant to move, raising the blank towards the tool. Whilst this is taking place the blank is given a partial revolution corresponding with the shape of the template. This is produced by the template being attached to an arm fixed to the bearing of the spindle, and held in a fixed relative position to the spindle itself by the dividing worm wheel. The machine is in no sense automatic, but it is very simple, and not likely to get out of order.

The milling machine also was represented by a number of interesting examples in the exhibit of the Maison Colmant. One of the finest is shown in Fig. 21. It is a horizontal machine of Series M, and is noteworthy on account of the stiffness of the design. This has been secured in a large measure by providing very wide bases to the carriages and broad flat wearing surfaces. The great solidity of the table may also be noticed. The countershaft forms part of the machine. It is not visible in the engraving. In the larger sizes there is a two-step cone, in the smaller size only one diameter. The table has a transverse motion operated by hand, and a longitudinal self-acting, or hand travel, with adjustable automatic knock-out. During work the table is rigidly bolted to the base. The tool carriage is counterbalanced, and is raised or lowered by a screw and hand wheel either from the front or side. A scale and vernier are provided for accurate adjustment. The spindle is of steel corrected after tempering, and runs in hard bronze adjustable bearings. The extremity of the spindle is carried in a spectacle piece carried in a vertical column, which can be moved laterally to bring it as close to the work as possible. An intermediate support pendant from a stout tubular arm steadies the spindle close to the cutting tool. For certain classes of work the tool carriage is given an automatic vertical travel, and is fitted with disengaging gear. Helical gearing is employed throughout for the drive.

In the engraving an apparatus for vertical milling is shown, mounted on the spindle. It consists simply of a pair of bevel gears giving a secondary spindle rotation in a plane at right angles to the first. It can be swung round to any angle in one plane. The largest machine of this type has a longitudinal travel of nearly 5ft., transverse travel 16in., and vertical travel 22in. The table measures about 72in. by 16in., and the spindle has six speeds between 12 and 130 turns per minute, with a feed between ·15 and 1·3 mm. per revolution of the cutter.

A milling machine of the universal type was also shown. The principal casting of this machine is practically the same as for that just described, but the tool carriage and the longitudinal slide are quite different. Fig. 22 shows these features, and the universal tool holder, which having two motions at right angles, permits of the tool being placed at any angle in any plane. Graduated scales show the angles in two directions. The universal dividing head pivots from ten degrees below the horizontal to a vertical position, and its spindle has a rate of revolution proportional to the rate of travel of the table. Four plates give the usual divisions. There is a back centre which is fully explained by the illustration. A stay for supporting the end of the milling spindle can be attached to the tool holder when desired. The movements in this machine are the same as for that last described, and helical gearing is also used. It may be noted that the plate on the spindle of the universal head has twenty-four notches round its circumference, which affords a ready means of obtaining the usual division, which are multiples of 24. The spindle is revolved by a worm wheel, the worm of which is made slightly conical, and is capable of adjustment longitudinally so that wear may be taken up. It works in an oil bath. By pulling a button, the shank of which has three notches, the spindle can be reversed or stopped. This permanent arrangement has the advantage of obviating a change in the gearing when helices are to be machined, or when it is desired to return to straight-line work after twist work has been performed. The illustrations of this type of machine will be sufficient to show that the design is excellent, and we need only add that the workmanship leaves nothing to be desired. It is interesting, perhaps, to note how very dissimilar it is to the usual pattern of universal milling machines, in which the table is given a vertical movement and the height of the spindle is fixed. The example before us seems the more rigid design in many respects. The longitudinal travel in the three sizes of this machine which are made, is 60in., 42in., and 31½in., approximately. We have not entered in detail into the uses of the universal head and tool-holder, as they are well known to most of our readers.

A totally different type of universal milling machine is also made by the Maison Colmant, but was not exhibited. A word or two about it may be, nevertheless, acceptable. It consists of two horizontal beds at right angles to each other. On one of them a long table slides, on the other the tool carriage. On the latter the tool spindle can be adjusted vertically. The longitudinal travel of the table is 8ft. 8in. in the larger machine of the two sizes made, the transverse movement of the head 18in., and the rise and fall of the tool 12in. Two different tool heads can be employed, one for horizontal the other for vertical and oblique milling. For helix cutting the work is revolved by gearing operated by one pinion in a train moving along a fixed rack as the table travels. These machines are designed for horizontal and vertical milling and drilling, for machining straight conical and helical milling

cutters, for milling twist drills, taps, reamers, &c., for cutting helical or straight gear wheels. In a modification of the form the tool carriage is also capable of rotation about a vertical axis, so that milling at various angles to the horizontal can be done, of course in conjunction with a vertical feed.

A pair of simple profiling machines was also shown. In these an arm is pivoted at one end on the axis of several pulleys; at the other it carries a milling spindle driven by a strap from the pulleys, and supported by an arm. A compound, or a circular table, is provided for the work and the template, which is bolted to it. A roller on the arm, immediately under the milling spindle, bears on the edge of the copy and causes the cutter to rise and fall as the table travels.

Several lathes were also shown by this firm. They were all, if we may so put it, of the English type—flat shears, ordinary back gears, and so on—except that an apron, approaching the American pattern, was used, and that the "back" shaft was in front.

A remarkable bevel wheel cutter was also shown on this stand. It is the invention of M. Monneret, the managing director of la Maison Colmant. The peculiar feature about the machine is that it produces a slightly helical tooth. This it effects by causing the blank to rotate at the same time that the tool is making a cutting stroke. This involves the disadvantage of dissimilar wheels—it is evident that only a right and left hand can gear together—but secures the general advantages of helical gear, on which, judging by its extended use in their machine tools, French makers set great value. A general view of the machine is given on page ix., and it will be gathered from this engraving and the drawings opposite, that it is somewhat complicated. It consists of a heavy, nearly semicircular base, supporting a table pivoted at the centre, and capable of rotation through a considerable angle. Upon this table is mounted the arbor which carries the blank. To an extension of this base is bolted a poppet head fitted with a spindle and a five-step pulley fixed permanently in back gear, reducing the speed to one-fourth. A countershaft is mounted below in the base, and drives with a short vertical belt. Forged on the end of the main spindle is a slotted disc, in which slides an adjustable crank pin, which by the aid of a connecting-rod gives a reciprocating motion to a long slide. On the end of this slide is mounted the tool box, composed of four separate movable parts, by the combination of which the exact position of the cutting tool is secured. The tool holder proper swivels round a spindle terminating in a grooved pulley; a cord fixed at two points, not on the slide, passes round this pulley. The pulley is friction tight on the spindle, and as it is turned to the right or the left in travelling along the cord, presses the tool box against one of two stops—one for the cutting, the other for the return stroke. The cutting tool is angular in cross section, and may be of any kind, preferably of the well-known circular type. A flat-sided tool will cut a true involute tooth, because a rack or a crown wheel, equivalent to a circular rack, has a flat-sided tooth, and such a rack could be used to generate a conjugate bevel wheel which would have true involute teeth. The same principle has been employed for producing the cutters used in the Fellows gear shaper, and was described in THE ENGINEER of August 31st.

Premising, then, that we have a flat-sided tool moving in a straight line, we need a combination of three simultaneous motions to produce a helical bevel wheel:—(1) the cutting stroke of the tool; (2) the rotation of the blank; (3) a motion of the blank towards the tool, viz., the feed—in such a manner as will cause the tooth produced to be wider at the base than at the summit, and will give it the correct conformation. Let us consider the three elements in their order. No. 1 is practically disposed of already. It is too simple to call for further explanation. It is merely the reciprocation of the slide and tool box. No. 2, the rotation of the blank, is a more complex affair. The driving cone, through a reversing gear *c* section, drives a variable train of wheels, which transmits a definite motion to a longitudinal shaft. The ratio of the train is varied according to the number of teeth to be cut in the blank. This shaft, through a train of bevel gearing which can be traced in the sectional elevation and plan—Fig. 22—drives a shaft H H, on which is a long worm *g*, driven by a feather—see plan. It gears with a wheel of sixty-four teeth immediately above it, and feathered to the spindle for the blank. The pinion F_1 is free on the shaft H H, but can be keyed to it by the device h_1, when desired. It will be seen that by varying the train of wheels already mentioned, the number of strokes of the tool for one revolution of the blank can be arranged. (3) The formation of the tooth. On the blank spindle is keyed a toothed wheel *y*, meshing with another of the same diameter, which drives a disc and pin working a ratchet plate. This whole arrangement is seen very plainly in the general view. The ratchet wheel is marked b_1 in the plan. It drives two things. First, the long screw *g g*, of which the nut moves the long worm *g* to right or left, causing it to act like a rack, turning the worm wheel and blank spindle and giving the blank the required motion of rotation; and, secondly, it drives through a series of bevel wheels *m m* a screw *p*, which is always parallel to H H—see the cross section—right under the centre of the machine. A nut on this screw is fixed to a slide capable of movement

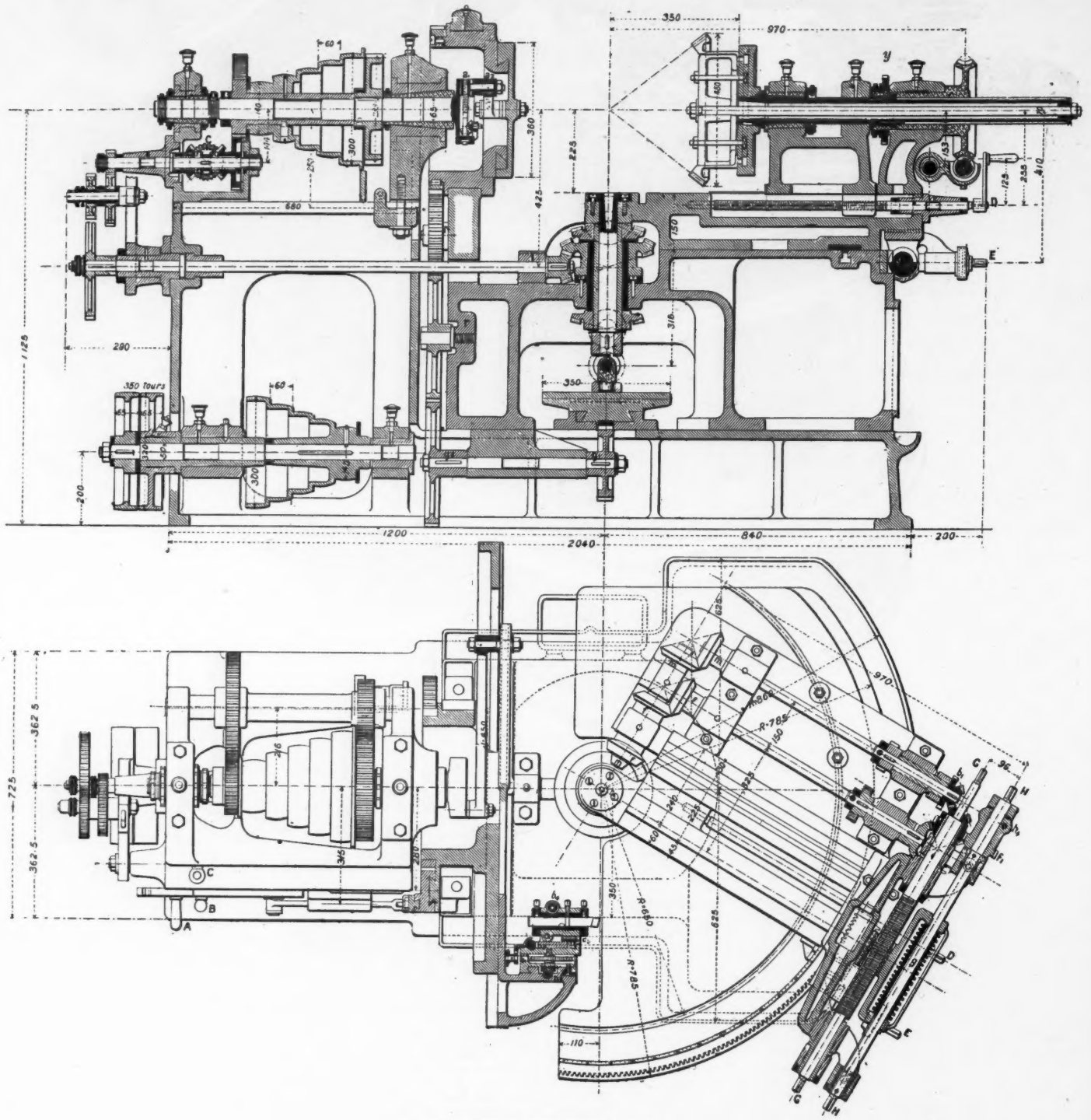
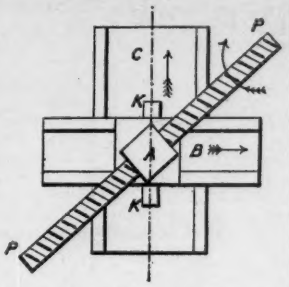


Fig 23—MONNERET BEVEL GEAR CUTTER

on the axis of the machine, and mounted in a second slide at right angles to the first.



The arrangement diagrammatically is thus. Now, if we imagine the screw P P turned in the direction of the arrow, it is clear that the nut A will move along the slide B in the direction of the horizontal arrow and the slide B along the slide C in the direction of the vertical arrow, and the amount of movement of the latter will be proportional to the angle of the screw. Now beneath the slide B is fixed a rack K K in the diagram, and clearly shown in the cross section—Fig. 24. This rack gears with one of a train of wheels, of which the last member meshes with teeth on the back of the tool slide. It must be borne in mind that all the gear described under this heading, No. 3, acts only once in a revolution of the blank. The result of the movement of the tool slide will be best understood from another diagram. Let us for the moment suppose that a plain involute gear is being cut, and that a cutter B moves to and from the reader. It is evident that it acts precisely like one tooth of a rack, and if the blank A is revolved at the correct speed whilst the cutter is descending in direction of the arrow, true involute teeth will be cut in it. This is precisely what is done by the machine, the blank being given a small part of a rotation by the longitudinal movement of the worm, at the same time that the tool is made to descend in the right proportion.

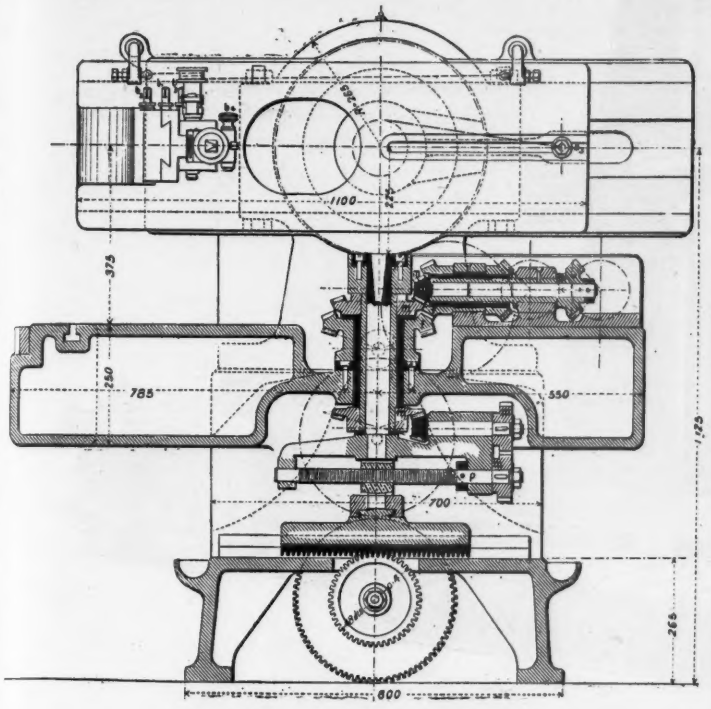
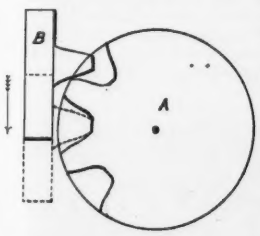


Fig. 24—MONNERET BEVEL GEAR CUTTER



The mathematical questions involved by this very elegant method are exceedingly simple, but it is hardly worth while entering into them. The machine itself is complicated—far more so than the English machine we described not long since—and it is doubtful whether the advantages of helical gear are sufficient to balance the extra expenditure on the purchase and upkeep of a costly tool, but in any case the inventor is to be congratulated on the ingenious design, and the manufacturers on the excellence with which it has been carried out. It is probable that such a machine will meet with far more favour in France than in this country, and it is noticeable, as we have already said, that the use of helical gears in machine tools is already largely in evidence in French tools. In conclusion, we wish to express our thanks to M. Monneret for the courtesy he has shown in aiding us in the preparation of this description of his clever machine.

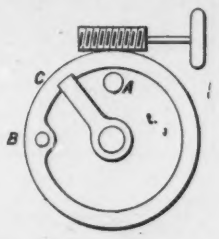
We have not gone into the question of the adjustment of the machine for working. Ample provision is made for this purpose. The chief points to be considered are the setting of the point of the imaginary generating cone of the blank at the geometric centre of the machine. For this purpose a little pillar, fitting into the steel bushed taper hole in the top of the vertical spindle, is provided. A rule is pivoted at right angles to it, and the side of the rule is made to touch the inclined face of the blank truly, the latter being moved in and out until this is secured, when the slide is clamped in position. The radial movement of the carriage is also made easy by a graduated ring, the adjustment being made by a worm wheel in a circular rack-cut fixed to the base. When adjusted this is also firmly clamped, so that no motion of the blank except rotation can take place. It should be remarked that all the faces on one side of the teeth are finished first, and then, by altering the direction of the machine, all the other faces, the right space between the teeth being arrived at by adjustment of the blank.

SCULFORT ET FOCKEDEY, MAUBEUGE.

A stand at the Exhibition which shared the honours with the Usines Bouhey of being the most striking in the French Section was that of Sculfort and Fockedey, of Maubeuge. Most of the tools shown were large. The two which we have selected for illustration were the most remarkable on this account. Unfortunately we have been obliged to prepare engravings from photographs taken in the Exhibition and under the awkward condition there presented, and they scarcely do justice to these fine tools.

The exhibit comprised a planing machine, with particularly rapid return motion. It planes a length of 9ft. 9in. by over 4ft. wide and 3ft. 3in. deep. The tool slide has a vertical motion of some 14in. The table is driven by a cut steel rack. There are two strong tool boxes, with self-acting motions, and gear for raising the cross slide rapidly without special overhead gear. Straight belts are used for both the cutting and return stroke.

A universal planing machine which is illustrated on the next page, presents, it will be seen, some peculiarities. On account of the limited space the bed was cut very short for the purposes of exhibition, and is so shown in our engraving. It has a forged steel octagonal tool bar, which can be given a longitudinal motion for cutting into holes and recesses. Motions for planing longitudinally and vertically are also obtainable, and provision is made for changing from any one motion to any other rapidly. There is only the one drive for these three independent actions, and a pretty device is used for regulating the stroke in each case. Its action will be gathered from the annexed diagram. Here A is a fixed pin, and B a pin projecting from the edge of a ring, which can be rotated by a worm and hand wheel. Between A and B is a lever C fitted on a sleeve keyed to a part of the mechanism, and rotating as any one of the strokes takes place. When it presses against either the pin A or B it changes its position on its shaft and causes the stroke to reverse. The stroke is therefore proportional to the distance between A and B, and this is readily adjustable. The longitudinal and transverse motions are actuated by screws, the cross travel of the bar, which can be inclined to a considerable angle up and down, by a strong rack and pinion. The bar and its carriage are counterbalanced. All the motions have a quick return. The maximum travel along the bed is 9ft. 9in., the stroke of the bar 6ft. 6in., and the vertical rise 4ft. 6in. The total weight of the machine, independent of the base, with ⊥ slots, is 16,000 kilos., or approaching 16 tons. The slotted base



is provided to suit requirements. The machine has been designed to attack heavy parts, which cannot very wel be placed on existing tools, suitable for the class of work. Two tool boxes are supplied. They can be fitted in various positions on the head to suit different conditions of work. One tool box is shown on a block resting on the base-plate. From the above short description it will be seen that both in its general design and the care which has been exercised in the details, that this is a very remarkable and excellent tool. All the motions are controlled from the table at the end. Electric driving was adopted perforce at the Exhibition.

Two shaping machines were shown, one with a 31in., the other with a 16in. stroke. The larger is driven by a rack, the smaller by a connecting-rod. In both the length of the stroke can be regulated whilst the tool is at work; and the heavier machine has two tables with power movements, and practically universal adjustment of the head. As in all the machines on this stand, the convenience of operation has been carefully considered.

Four drilling machines were shown. The largest will drill holes up to about 4¾in. diameter. It has a radial swing of about 7ft. 6in., and the vertical rise and fall of the arm is 32in. The drill head can be swung to various angles. The weight of the arm and the thrust of the spindle is taken on ball bearings. It has full self-acting and reversing motions, and the operating levers are placed in convenient positions. Another radial drilling machine shown was similar in design, though not of the "universal" type, and a good deal smaller in size.

A fixed drilling machine for holes up to 2in. diameter was also shown, and a multiple drilling machine with six spindles. All the machines have ball thrusts on the spindles.

A slotting machine of very large size was shown. It is illustrated by Fig. 25. The stroke is given by a rack and pinion driven by a steel worm and bronze worm wheel, working in an oil bath. It has quick return motion. The guides for the slotting head have a vertical adjustment. The head itself is counterbalanced. The table, the construction of which is clearly shown by the engraving, has self-acting intermittent feeds in all directions, and also rapid continuous motion when desired, the change being made instantaneously. We had the pleasure of seeing this machine in action, and though it was not cutting, were impressed with its smoothness in running and the facility with which it could be operated. The principal dimensions are:—Maximum stroke, nearly 5ft. Distance from the tool to the column, 4ft. 8in.; greatest height under the tool box, 8ft. 3in.; diameter of the circular table, 5ft.; longitudinal travel of the table, 5ft.; transverse travel of the table, 4ft.; and the total weight of the machine is nearly 80 tons.

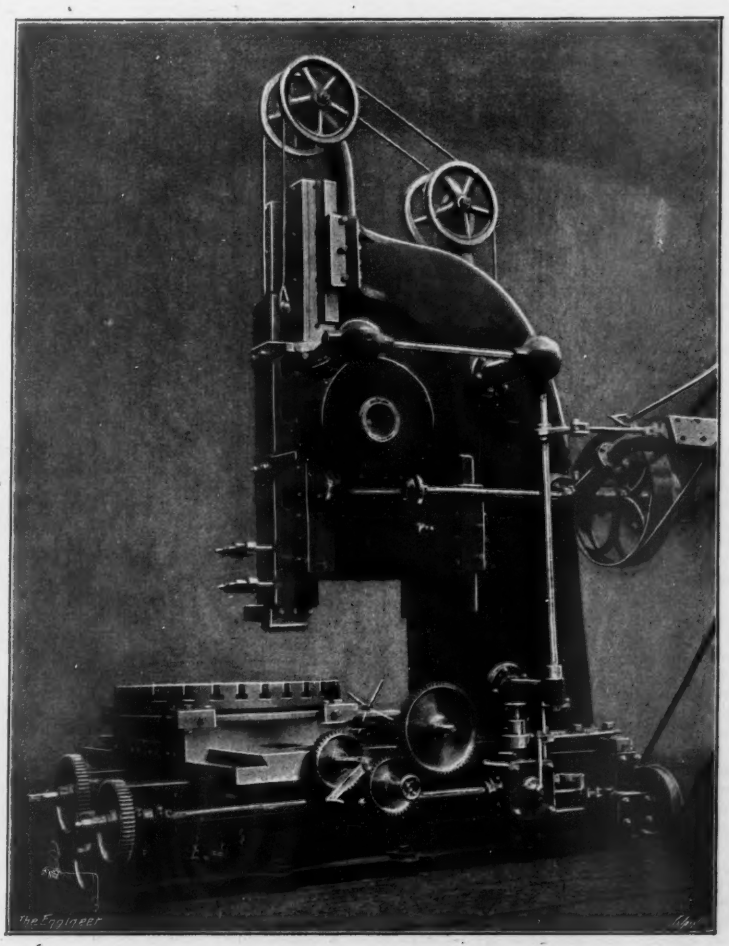
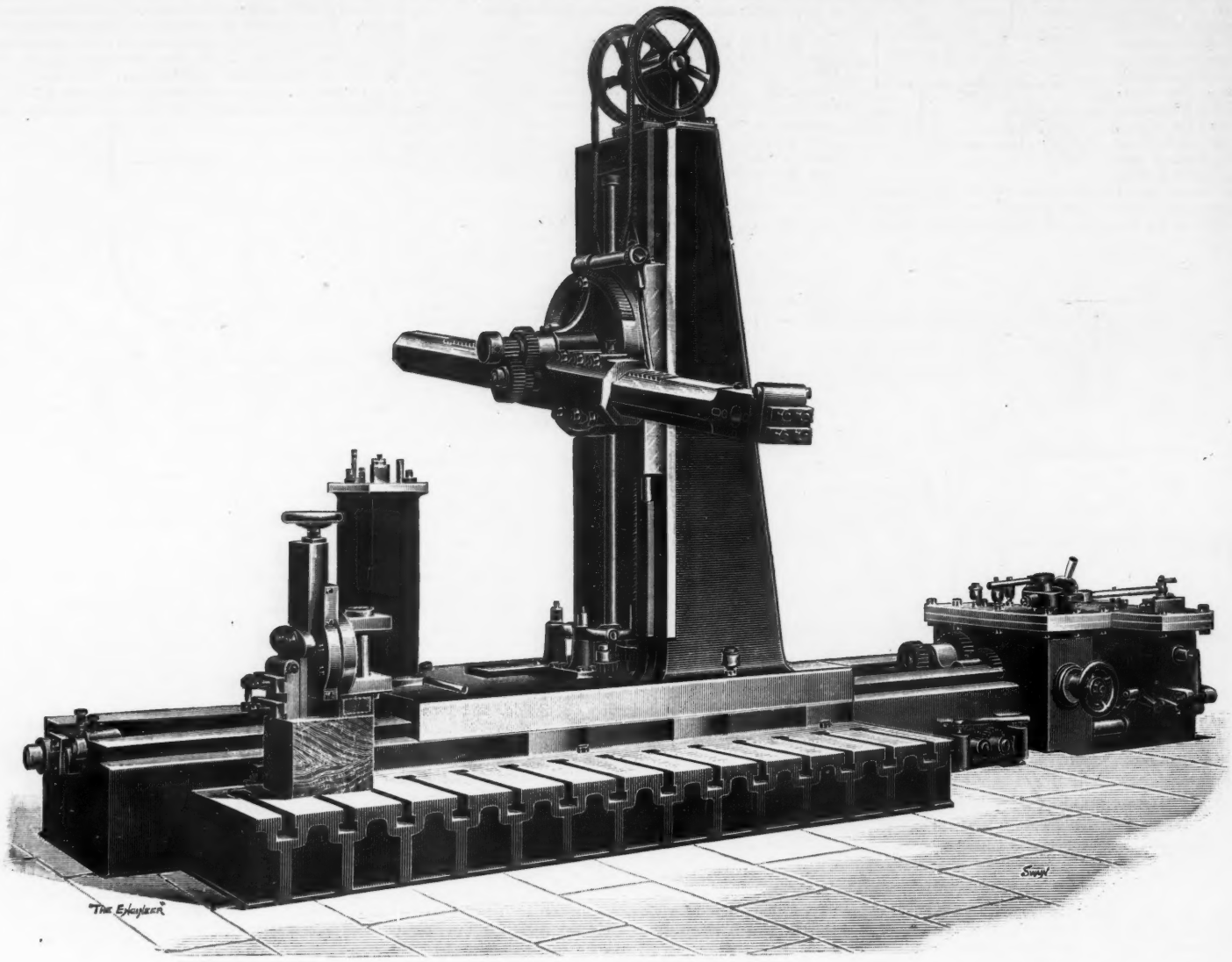


Fig. 25—SLOTTING MACHINE—SCULFORT ET FOCKEDEY

Several boring and milling machines were also shown by Sculfort and Fockedey. The largest was a boring machine for cylinders up to 34in. diameter. Ball bearings are largely used, as in the other machines by this firm, to take thrust.

UNIVERSAL PLANING MACHINE

SCULFORT AND FOCKEDEY, MAUBEUGE, ENGINEERS



Two other machines were of the vertical type, and another a universal type milling machine, with a table having a longitudinal travel of 32in. Three lathes were also shown. One a very large machine, with 4in. centres, triple back-geared, and having twenty-one different speeds of rotation. The face plate is driven by gearing cut in its periphery. It has two independent compound slide rests, and is fitted for screw cutting or surfacing. The back centre can be moved for taper turning. The lathe is fully self-acting. The maximum distance between the centres is 10 metres, say, 32ft. 6in. The others were a 10in. gap lathe, and an 8in. turret lathe, both of good design, but with characteristic American features, particularly noticeable in the inverted vees on the shears, which are not, we gathered from conversation with several makers, highly esteemed in France, the flat form being preferred.

FORGES ET FONDERIES DE HAUTMONT.

A wheel lathe, which is claimed to be of novel design, has been constructed recently by the "Forges et Fonderies de Hautmont," and is described in *La Revue Technique*. It consists of the usual base with ⊥ slots, on which are mounted four pedestals, each provided with a slide rest. From the centre of the base rise two annular cheeks of cast iron, separated by distance pieces, and held together rigidly by bolts. These two cheeks carry between them eight rollers with inclined faces mounted in adjustable bearings. A ring with teeth cut on the outside of it is guided by these rollers, and two bronze rings at its edges, and is driven by a pinion on the driving shaft, on which a five-step cone is mounted. The wheel to be turned is mounted inside this ring by suitable screws and clamps bearing against its periphery, and is attached by two slide rests at each side. It is thought that economy will be realised by the greater speed at which work can be effected, and because the double chucking of the wheel, necessary when an ordinary face-plate lathe is employed, will be avoided. It remains to be seen, but we imagine that difficulties will be experienced in getting the machine to run steadily, and in the centering of the piece to be turned. For railway work it would appear to have few if any advantages over the double wheel lathe. Another application, which seems more likely to be profitable, is for turning parts of large castings and forgings which it is difficult or impracticable to chuck. In this case the tools are held in suitable rests inside the ring, and rotate round the work, the latter being held on a table bolted to the base. A machine very similar in design has been in existence for years for turning crank pins.

TAPER SCREWING ATTACHMENT.

A useful attachment to their ordinary chasing saddle has been recently brought out by Alfred Herbert, Limited, Coventry. It is designed to facilitate taper turning and screwing, without interfering with the quick withdrawing motion which is a feature of their ordinary chasing saddle. A drawing of a saddle thus fitted is given on the next page, and a No. 5 capstan lathe provided with it is the subject of Figs. 26 and 27.

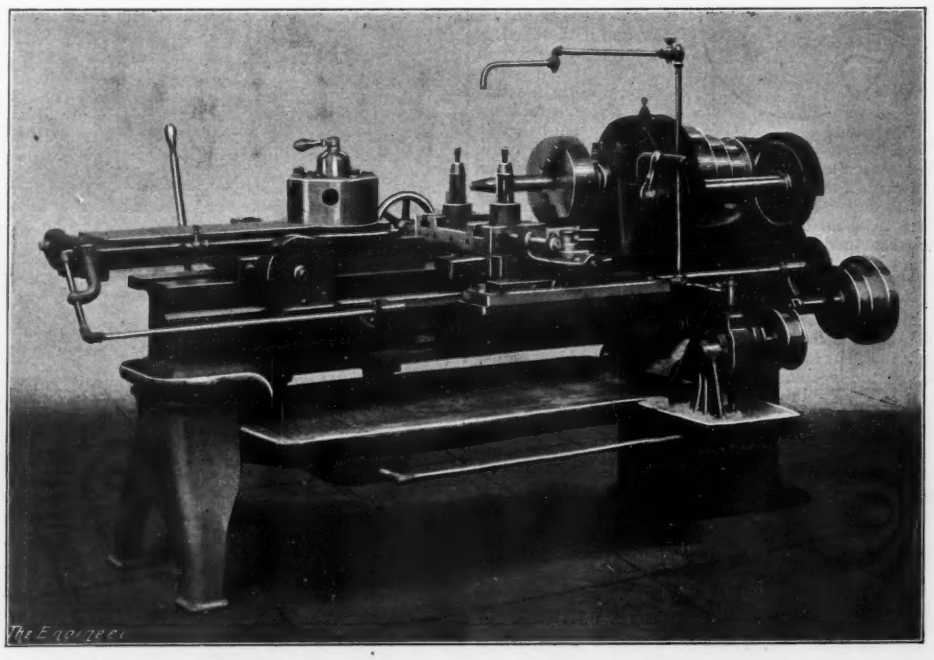


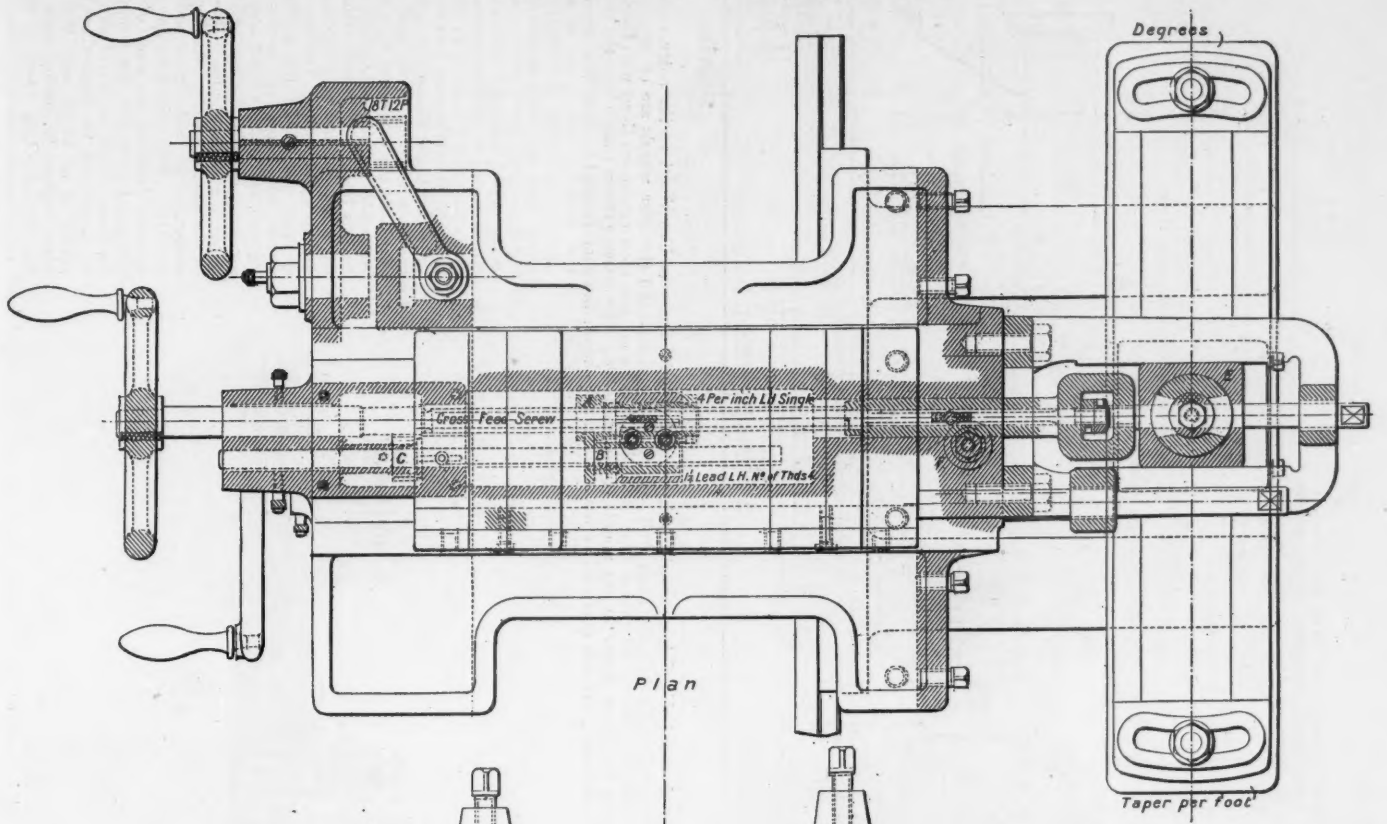
Fig. 28—CAPSTAN LATHE WITH TAPER SCREWING ATTACHMENT

By means of this quick withdrawing motion the tool is drawn back from the work and the nut from the lead screw simultaneously by the depression of a single lever. Raising the lever returns the tool to the exact position it left, or, if a slight motion has been given to the tool slide by a fractional rotation of the hand wheel on the cross screw, starts a new cut. Thus the chalking and adjustment required in an old-fashioned lathe are entirely obviated, and the work is better done with a less expenditure of time and skill. The mechanism employed to effect this object is very simple.

Looking at the drawing on page xiii, it will be seen that on the cross feed screw is a long nut A with a collar at each end. This nut is fitted in a hole in a lug on the lower side of the cross slide. The lug being shorter than the distance between the collars, the nut is allowed a certain

SADDLE WITH TAPER-SCREWING ATTACHMENT

ALFRED HERBERT, LIMITED, COVENTRY, ENGINEER



amount of longitudinal play. Through a second hole in the lug is another bush B screwed to a rapid pitch on the outside, and coupled to A by a flange shown. Through it passes a spindle with a featherway, by which it can be rotated. A pinion C—elevation and plan—is keyed to the end of this spindle, and meshes with a pinion D—plan—keyed on the quick withdraw lever spindle. On an extension of this pin is cut a worm which gears with inclined teeth cut on the top of the slide carrying the lead screw nut. This nut, it should perhaps be remarked, moves horizontally, not vertically. By depressing the lever a double effect is produced. The worm withdraws the lead nut, and the screwed bush B draws the tool slide back, the lug sliding on A till it is arrested by the collar. Now the ordinary taper turning attachment also moves the tool slide for the purpose of obtaining the taper, and, it is evident, would conflict with this quick withdrawing motion if taper chasing were attempted. But in the device described it is manifest that the quick withdrawing gear is independent of the cross feed screw, the tool slide being held rigidly by the screwed bush and the flange on it. Taper turning can therefore be readily effected by moving the cross feed screw endways, of course without rotating it. The manner of doing this is shown in the illustrations. The taper turning attachment consists of a V slide, which can be inclined to any angle, and is clamped to an adjustable bracket bolted to the back of the lathe. It is very clearly shown in Fig. 25. Upon this V there slides a block E—plan—guided between the faces of a bracket bolted to the saddle—see elevation. Now the cross feed screw takes its bearing in a long bush, fitted in the back of the saddle; it has no longitudinal play in this bush, but the bush can slide freely through the saddle except when clamped by the nut F. The bush is continued beyond the stirrup by a stalk passing through the block E, to which it can be clamped when desired. When fast here and free at F, the slide turns a taper parallel to the vee slide. When, on the other hand, it is free at E and clamped at F, the slide is arranged for parallel turning. In either case it is evident that the withdrawing motion can be used, and thus taper screwing can be done as readily as parallel screw cutting. It may also be noticed that, on account of the ease with which the change from parallel to taper turning can be made, it is profitable to do both at one chucking.

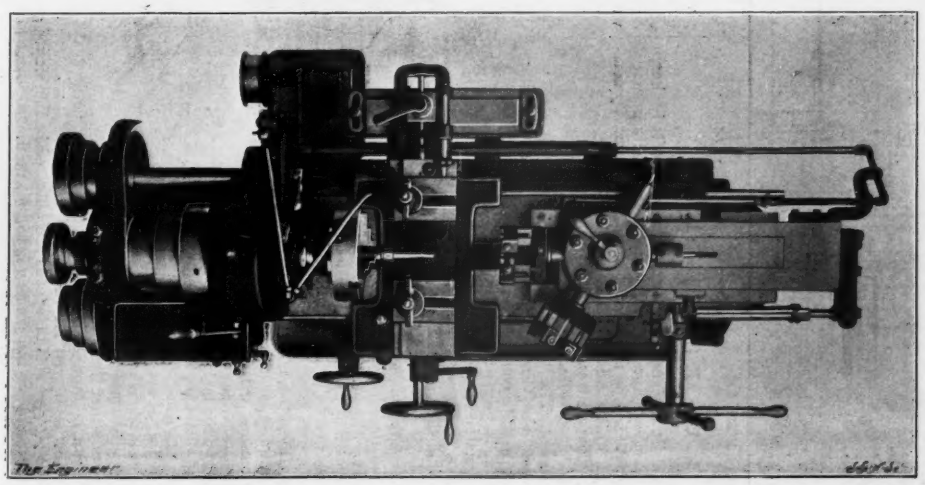
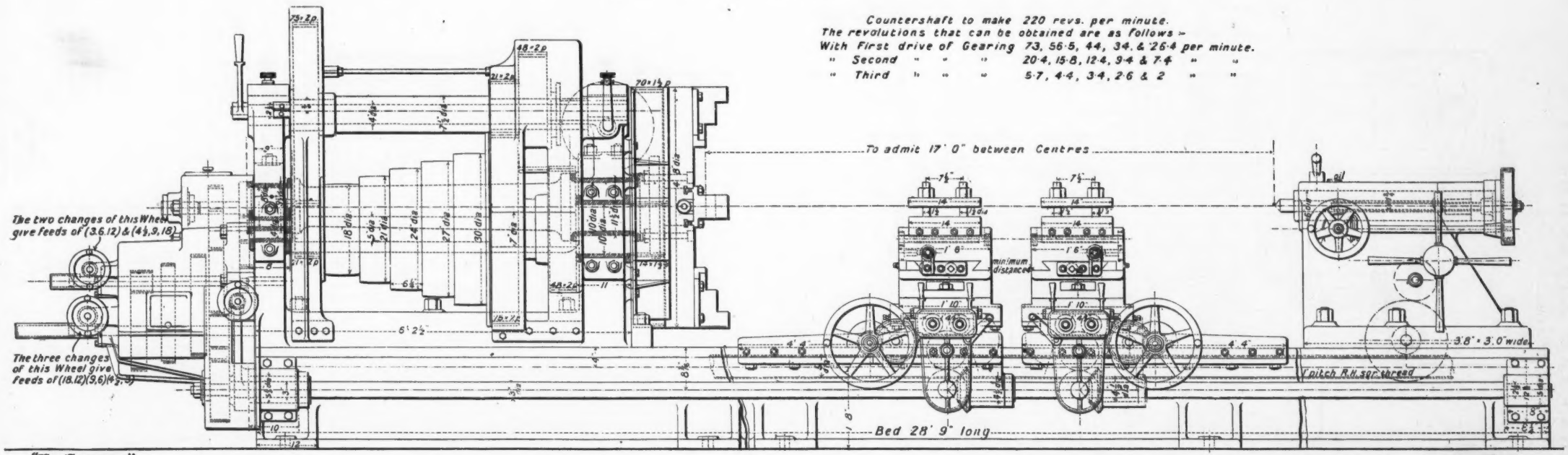


Fig. 27—LATHE WITH TAPER SCREWING ATTACHMENT—PLAN VIEW

CRANK SHAFT LATHE

DEAN, SMITH AND GRACE, LIMITED, KEIGHLEY, ENGINEERS


Countershaft to make 220 revs. per minute.
The revolutions that can be obtained are as follows :-
With First drive of Gearing 73, 56·5, 44, 34, & 26·4 per minute.
" Second " " " 20·4, 15·8, 12·4, 9·4 & 7·4 " "
" Third " " " 5·7, 4·4, 3·4, 2·6 & 2 " "
To admit 17' 0" between Centres
The two changes of this Wheel give Feeds of (3.6.12) & (4½,9,18)
The three changes of this Wheel give Feeds of (18.12)(9,6)(4½,3)
Bed 28' 9" long
3'8" × 3'0" wide
1 pitch R.H. sq. thread
minimum distance
oil
"THE ENGINEER"
SWAIN ENG.

CRANK SHAFT LATHE.

A lathe specially designed for turning crank shafts is shown in the general view below—Fig. 28—and some of its principal details are illustrated by drawings. It has been recently completed by Dean, Smith, and Grace, Limited, of Keighley. The centres are 28in. high, and a diameter up to 42in. can be turned over the saddles. The lathe has been designed to meet the vibration produced by heavy cuts in this class of work, and is very generously proportioned throughout. An inspection of the drawings will make this clear. All gear wheels are cut from blanks, and the pinions in all cases are solid with their shafts. All the driving takes place through the pinion A—section next page—and the spur wheel B behind the chuck plate. The pinion A has a bearing 10in. diameter by 11in. long. Fifteen different speeds can be given to the chuck plate. They are 2, 2·6, 3·4, 4·4, 5·1, 7·4, 9·4, 12·4, 15·8, 20·4, 26·4, 34, 44, 56·5 and 73 revolutions per minute. These speeds are obtained through a five-step cone and three changes of gearing—see next page. When the fast speeds are used the cone drives direct through the pinion A, whilst the excentric shaft C and the wheels mounted on it are put out of gear by the worm and wheel shown.

By unlocking the cone at D and lowering the top gears either the wheels E and F or G and H can be brought into action, the lever I being employed for the purpose. The two slowest sets of speeds are obtained in this way. The careful guarding of the gearing is to be noted. A device for regulating the feed is shown on the drawings.

On the end of the main spindle is seen the gear J, which gives motion to gear K and then to all the feed mechanism, or can be slid along the spindle out of gear. On the same shaft, and revolving with gear K, is gear L, both gearing with wheels on the shaft M at different ratios, so that with a sliding key working in the last-mentioned wheels, two different speeds are given to wheels N, O, and P. These, again, gear with wheels on the shaft Q at different ratios, which also have a sliding key, and thus six different speeds can be given to the shaft Q and pinion R solid with it. The pinion R gives motion to two sets of reversing gears, mounted on suitable plates, one of which—shown at S on the drawing—gives through the shaft T all the surfacing feeds to the saddles, while the traversing feeds are obtained by a 5in. diameter 1in. pitch screw in the middle of bed, driven by the other reversing plate and gears before mentioned, and which cannot be seen on the headstock drawing. This arrangement permits the reversing of either feed, or of stopping the same, independently of the other. In passing, it will be noticed that the reversing operation is done through a hand wheel, worm, and quadrant on the outer edges of the reversing plates. All the gear wheels are of steel, and those that revolve on the steel shafts are lined with Babbitt metal dovetailed in. The drawing shows clearly how the sliding keys are manipulated; the shaft marked U slides and revolves with the shaft Q, and is cut in a circular manner—to permit the revolving of the same—with rack teeth, so that by revolving the lever V, which is on a shaft having at the other hand a rack pinion solid with it and gearing in the last-mentioned rack teeth, the shaft U is made to slide in the shaft Q. It can be seen that this shaft is connected to the sliding key, and operates the same according to the feed required. The tools are supported in a solid tool box, which has no overhang, but is stayed directly from the lathe bed, so that springing is impossible, and the tools are kept well up to their work. The back rests are specially constructed for cutting in the cranks, and being very narrow for that purpose, are made of steel, and well fastened by bolts to the base slide directly under the cutting edge. The saddles can be manipulated, *i.e.*, the stopping and starting of all feeds—from both sides of the lathe. The loose head has also been specially designed, the shape of the body being such as to give direct support from the base. It can be moved along the bed by power, and the hand wheel has been placed so as to be near the operator while engaged in placing work between the centres. End views of the saddle and the poppet head are given on the next page. Suitable arrangements have been made for oiling all the moving parts of this fine machine. The weight of the lathe is 80 tons.

It is interesting to remark that it is in work of this class,

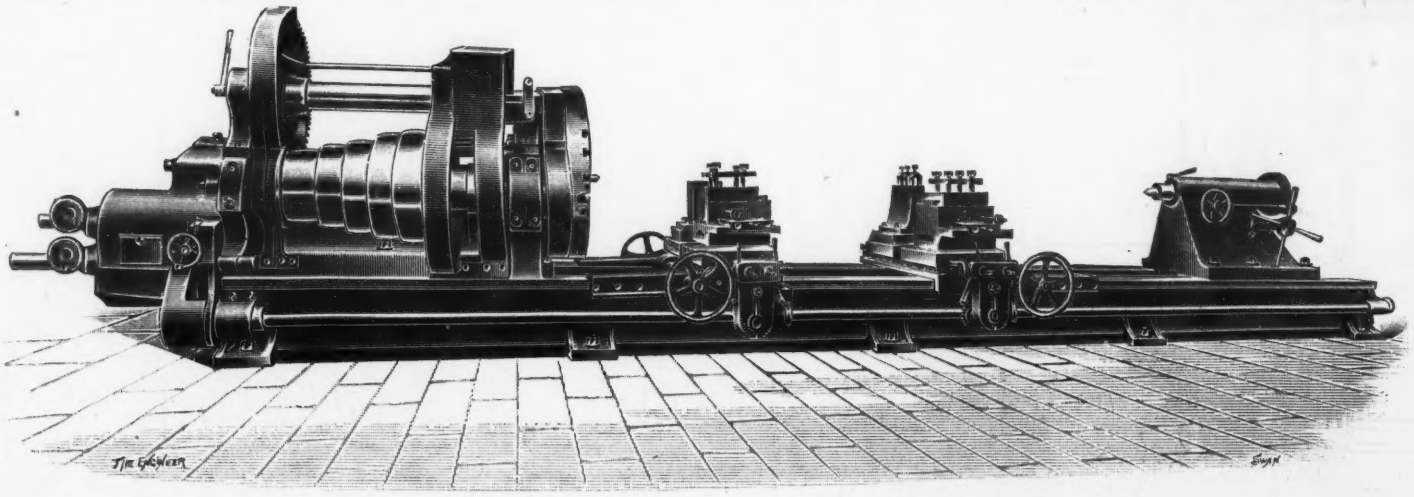
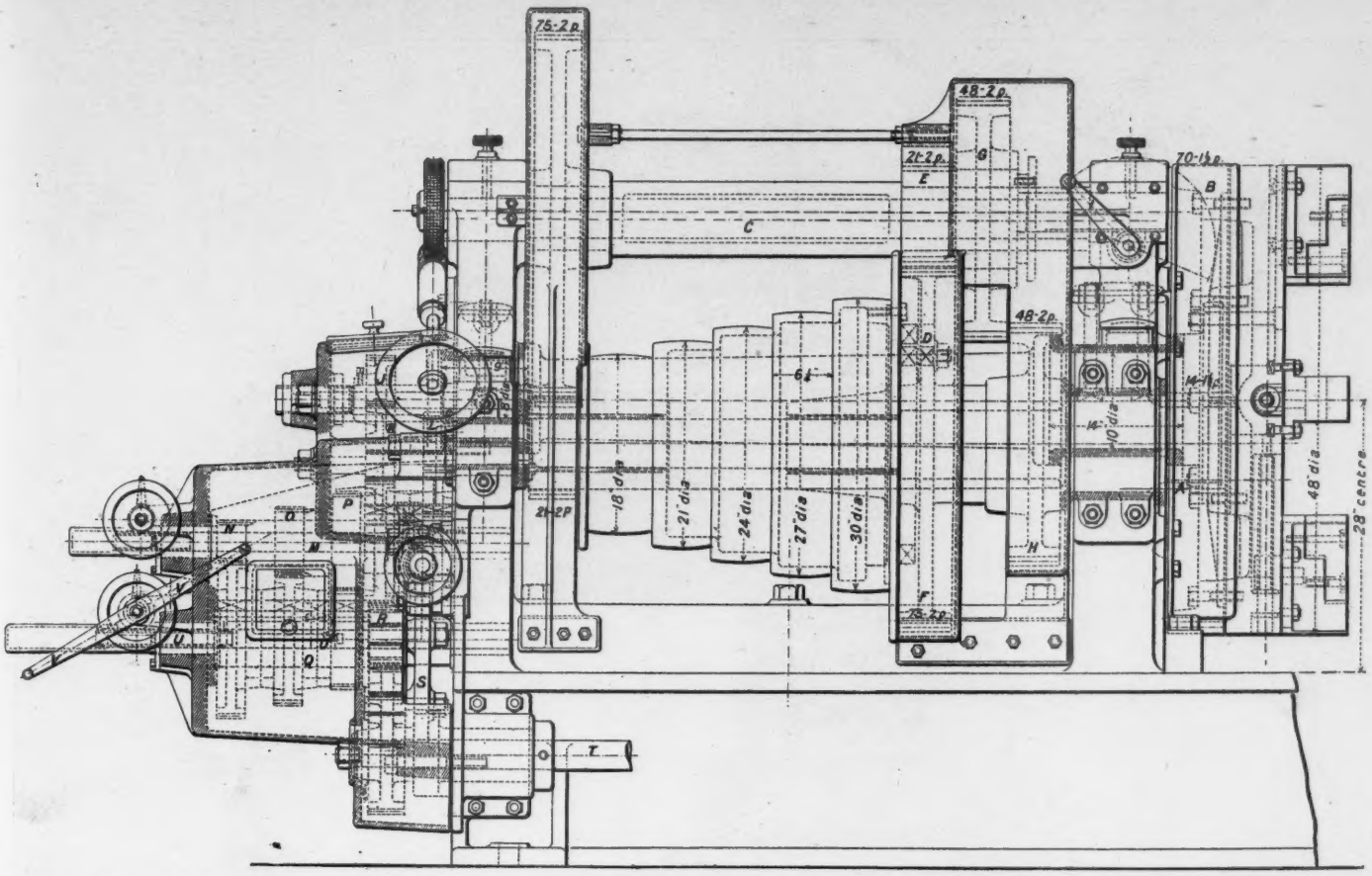
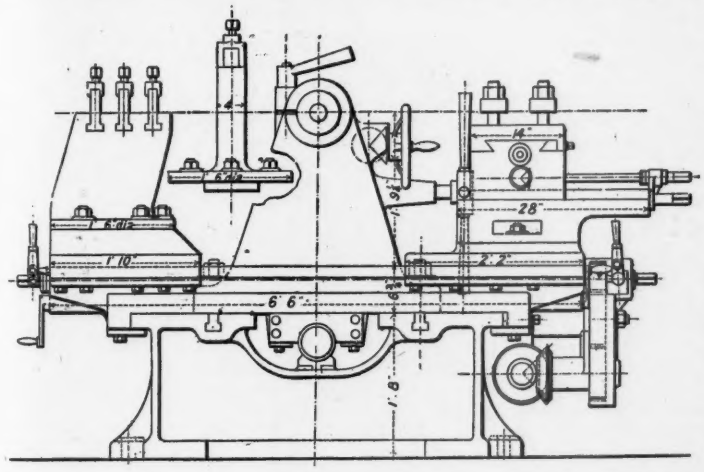


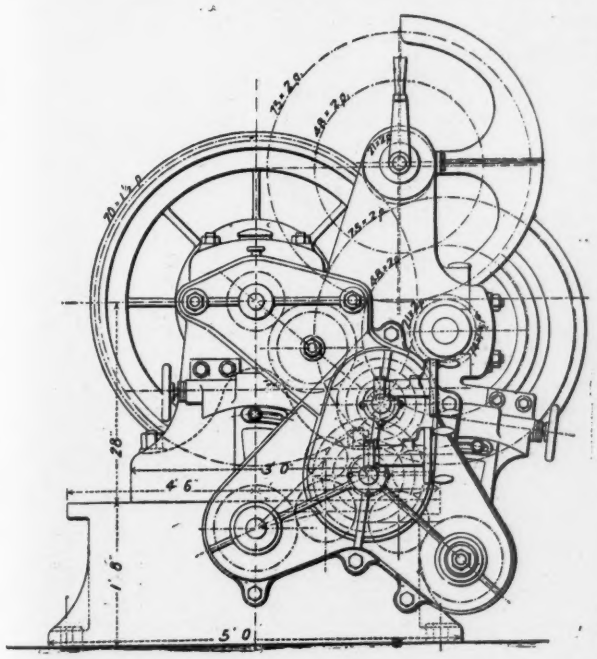
Fig. 28—HEAVY CRANK SHAFT LATHE

CRANK SHAFT LATHE, HEADSTOCK AND GEARING



represented by the excellent example before us, that this country has at present nothing to fear from continental or American rivalry. In the design of machines of the largest type Great Britain cannot be excelled, and there are comparatively few American or continental works which make tools of this class that can equal ours.





FOUR-SPINDLE SEMI-AUTOMATIC LATHE.

Amongst the machines at the Stanley Show, the multiple spindle semi-automatic screw machine exhibited by C. W. Burton, Griffiths, and Co., of Ludgate-square, is of exceptional interest. It is a machine of continental origin, but the influence of American design is very pronounced. It is illustrated by Fig. 29, and a general view on the next page, which so far explains it to those who are acquainted with automatic screw machines that little need be said about it. It has four spindles operating at one time, and is estimated to have an output from three to four times that of a single spindle machine. It is semi-automatic, and requires the sole attention of the operator. It is in this respect like the capstan lathe, and as the capstan lathe is more rapid in production than a full automatic, so this machine makes up for the call on a workman's time by a proportionately greater output. What the advocates of the "one-man-one-machine" principle will have to say about it remains to be seen. Virtually it is four machines in one. The four bars of stock supported in a suitable ring bearing pass through four ordinary wire feeds, of which one only is in position for action at a time. The feed of the stock is effected by hand. Four tools are fixed in a vertical head sliding on a broad flat shear, and are worked forward by a large cross lever. The four tools operate on the four bars simultaneously, and at the same time two side tools, one above and one on a cross slide, can be employed. The former can be used for chasing when desired. Normally, screw cutting is effected by dies in a special holder. The spindle head rotates automatically, or it can be revolved by hand when desired. The machine is made in two sizes, of the following dimensions.

Size.	No. 1.	No. 2.
Diameter of hole in spindle	1½in. to 1 7/8in.	2in. to 2 1/8in.
,, ,, through wire feed for steel	1in.	2in.
Diameter of hole through wire feed for brass	1½in.	2in.
Diameter of spindle	2in.	3⅛in.
Largest diameter that can be chucked	3¼in.	4⅜in.
Diameter of holes in turret	1¾in.	2 1/16in.
Diameter of cone	10½in. by 8in.	16in. by 14in.

The small slide on the top has automatic travel and traverse independently or combined; that is to say, the tool can be arranged to cut downwards to a given depth where it stops automatically and starts cutting sideways till it reaches the stop. The upper circular piece seen on the side of the head is a dial showing the number of pieces machined, and the screw in the middle of the head is a brake to check the rotary motion of the spindle drum.

Another interesting machine is also shown for the first time by the same firm. It is the triple-action chucking lathe invented by Mr. Brockie, and referred to on a former occasion. We shall probably have an opportunity of illustrating it in a future issue. It is a very simple machine, in which the ordinary bed of a lathe is not used, and in which there is neither slide rest nor turret, in the accepted sense of the word. It consists of a spindle with a three-step cone, and a self-centering or special chuck. At each side, but on a lower level, are two spindles, each of which carries on a short arm a tool slide or carrier. These spindles are caused to rock about their axes by the action of a cam on a shaft under the step cone. This action brings the tools in the slides down upon the work held in the chuck. At the same time a central ram immediately below the mandril bearings is caused to slide by a cam, and advances a drill or

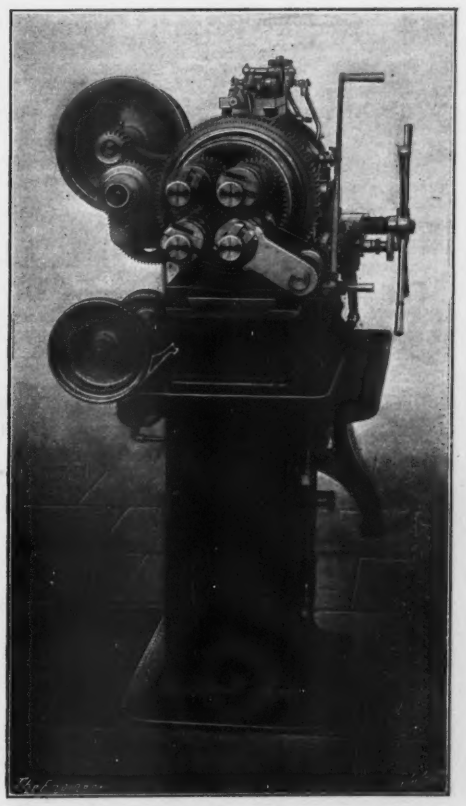
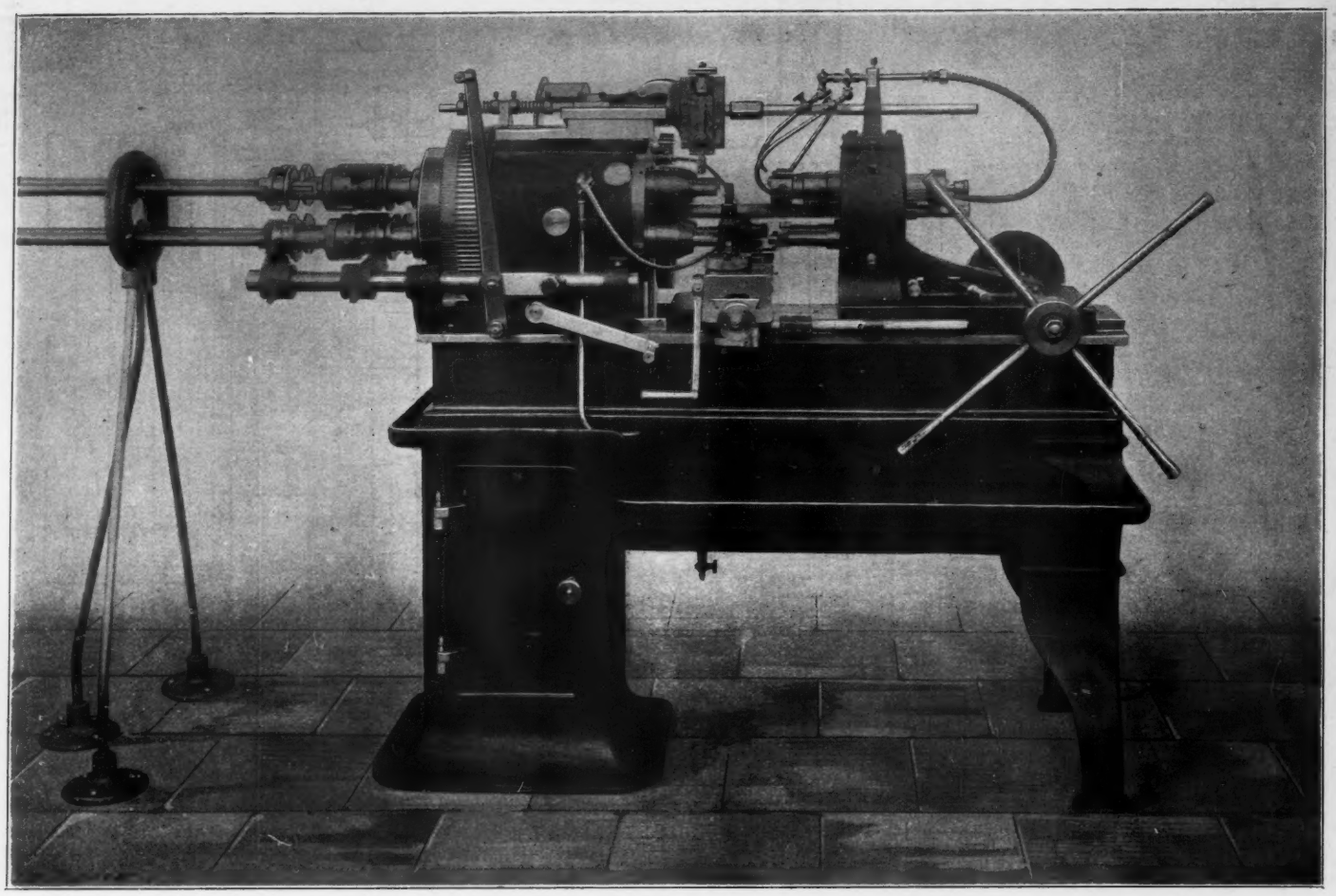


Fig. 29—FOUR SPINDLE LATHE—END VIEW

FOUR-SPINDLE SEMI-AUTOMATIC LATHE



other tool, held in a carrier at its end, towards the work. The side tool holders are of two kinds. They are adapted to carry either one tool each or two separate tools each. In the former case an adjustment is provided, so that two or more cuts in succession can be taken, the motion being strictly limited by micrometer stops. In the latter, one tool can be used for a roughing and the other for a finishing cut, or for entirely separate operations. The central carrier takes three tools when necessary. The cams are driven simultaneously by a worm wheel, and during one complete revolution the three tools take the cuts, return to the starting points, and then stop automatically. Screwing is effected by a pattern hob causing one of the side bars to traverse. It will be seen from this brief description that the machine has many novel points, and for a certain class of chuck work it appears to be eminently suitable. The size of work which can be chucked is 6in. diameter.

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Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and, in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of The Engineer.

Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

PUBLISHER'S NOTICES.

*** *With this week's number is issued a Sixteen-page Supplement on Some Continental and British Machine Tools. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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REPLIES.

Navy (Chatham).—We think not. More than one case like yours has come within our knowledge, and the result has been unsatisfactory.

T. L. (Plymouth).—You cannot do better than consult the "Abstracts of Patent Specifications," which are filed at all the principal libraries throughout the country. It may also be of use to you to read a paper entitled "The Various Systems of Railway Fog Signalling," by Mr. W. S. Boult, which you will find in our issue of June 9th, 1899.

INQUIRIES.

HORSESHOE CUTTING AND BORING MACHINES.

Sir,—We want the address of one or two English makers of horseshoe cutting and boring machines by hand power.

November 16th. S. and P.

MEETINGS NEXT WEEK.

The Society of Model Engineers.—Saturday, December 1st, Annual Conversazione at the Memorial Hall, Farringdon-street, E.C.

The Institution of Junior Engineers.—Friday, November 30th, at 8 p.m., at the Westminster Palace Hotel. Presidential address by Sir Lowthian Bell, Bart., F.A.I.

City of London College Science Society.—Wednesday, November 28th, at 7.30 p.m. Paper, "Wrinkles in Patent Law and Practice," by Mr. W. J. Tennant, F.C.I.P.A., A.M.I.C.E.

The Staffordshire Iron and Steel Institute.—Wednesday, November 28th, at 7 p.m., at the Institute, Dudley. Paper, "The Chemical Phenomena of Puddling," by Lieut.-Col. L. Cubillo, Assoc. Inst. C.E. (Royal Arsenal, Trubia, Spain).

Society of Arts.—Monday, November 26th, at 8 p.m. First Cantor Lecture on "Electric Oscillations and Electric Waves," by Prof. John A. Fleming, M.A., D.Sc., F.R.S.—Wednesday, November 28th, at 8 p.m. Ordinary Meeting. Paper, "Malaria and Mosquitoes," by Major Ronald Ross.

Hull and District Institution of Engineers and Naval Architects.—Tuesday, November 27th, at 7.50 p.m., at the Technical School, Park-street. Papers, "Corrosion in Marine Boilers," by Mr. J. Brackenbury; "Electric Motors *v.* Belting for Driving Machinery," by Mr. W. H. Willatt; "High-speed Engines and Ships," by Mr. F. Somerscales.

The Institution of Civil Engineers.—Tuesday, November 27th, at 8 p.m. Paper to be discussed, "The Metropolitan Terminus of the Great Central Railway," by Mr. George Andrew Hobson and Mr. Edmund Wragge, MM. Inst. C.E. Paper to be read, "Machinery for the Manufacture of Smokeless Powder," by Mr. Oscar Guttmann, M. Inst. C.E.—Wednesday, November 28th, at 2.30 p.m., Visit to the London and South-Western Railway Locomotive Works, Nine Elms.

DEATH.

On the 16th inst., at St. Oswald's, Grasmere, George Frederick Armstrong, M.A. Cantab., F.R.S.E., Regius Professor of Engineering in the University of Edinburgh, aged fifty-eight.

THE ENGINEER.

NOVEMBER 23, 1900.

FRENCH NAVAL REFORMS.

The several decrees recently promulgated by the Minister of Marine would seem to show that M. de Lanessan is fully alive to the importance of giving a good account of his stewardship during the forthcoming debate on the naval estimates in the Chamber of Deputies. Unlike some of his predecessors who had programmes of their own which they endeavoured to carry out, whether or not they had the approval of the Counseil Supérieur de la Marine, M. de Lanessan has entered upon his task with a perfectly open mind, and all the measures he has taken have received the full sanction of the permanent Council. He is less an originator himself than an adaptor of other people's ideas. He puts his hand on anything that may be turned to good account, and all his naval reforms are built up with planks from the "platforms" of those who have preceded him. The separation of the bureau of naval construction from what may be termed the executive bureau, is clearly suggested by M. Lockroy's plea that it is desirable to "fix responsibilities," and it is probable that this is a step in the direction of separating the vessels afloat from those on the stocks. M. de Lanessan is an enemy to centralisation. He is anxious to have each department of the marine under a distinct administration, so that each will be able to concentrate its energies upon the particular work to be done, and be rendered responsible for any faults or mistakes in the carrying out of this work. Thus in future the bureau of naval construction, which has up to the present had charge of everything in connection with the arsenals, will only have to occupy itself with the building of ships, their repairs and maintenance; while the new bureau will have control of the draughtsmen and workmen and the purchase of material. The bureau of naval construction will be placed under the direction of a naval engineer, while the executive bureau will be administered by an official in the civil service. In this way it will be possible to avoid the tinkering with plans which has proved so costly in the past; and to prevent the mysterious waste of money upon material for which no explanation has been forthcoming. By rendering the head of each department responsible it is expected that the work will be done more expeditiously and cheaply than heretofore. But it is not the intention of M. de Lanessan to make this creation of bureaux a burden upon the ratepayer. In forming one he suppresses another of doubtful utility; and the executive bureau takes the place of the *corps assimilés* which has been deprived of its last vestige of power by handing its jurisdiction over the officers of the fleet to the naval staff. The tendency of M. de Lanessan's reform is thus perfectly clear. He is making a distinction between the naval and civil administrations, and is giving to each the duties which naturally fall within its scope.

To a certain extent the Minister of Marine has anticipated the criticism of M. Fleury-Ravarin, who has just issued his report upon the grants to be asked for by the Naval Commission, and in this report he strongly insists upon the necessity of depriving the naval staff of administrative duties, so that they may confine their attention exclusively to war preparations. He thinks that an admiral should keep his ships in good fighting trim, and not worry himself over the commissariat or the pay of the men. He also suggests that the Minister of Marine should be assisted by a superior naval officer in his attempt to carry out reforms in naval construction and in the military equipment of ships. Now this is very unkind of M. Fleury-Ravarin. It is so obviously a slap at a previous Minister who obtained some notoriety by his refusal to listen to the counsels of naval experts placed over his department. The Conseil Supérieur de la Marine, with a capable officer at its head, has always existed for the guidance of Ministers of Marine, and it will be remembered that during M. Lockroy's term of office the chief of the consulting body threatened to send in his resignation because the Minister persisted in carrying out measures of which he was unable to approve. M. Fleury-Ravarin fails to point out how a refractory Minister can be compelled to submit his reforms to the permanent staff. It is probable, however, that measures of this kind will find favour in such an amiable reformer as M. de Lanessan. He is not only desirous of improving the administrative system, but he has recently been giving a good deal of attention to the new scheme of coast defence. Accompanied by the Minister of War, he has visited Corsica, which it is intended to convert into a sort of French Malta. During the last debate on the budget estimates, the Government asked for a sum of 550,000f. for carrying out submarine works in Corsica, but M. Camille Pelletan succeeded in inducing the Chamber to vote 6,000,000f. for the construction of ports. There are three ports which would seem suitable for military defences—Ajaccio, Bonifacio, and Porto-Vecchio. In undertaking this journey the Minister desired to see what could be done to defend all these ports, and at the same time ascertain whether one or the other could be employed as a torpedo station and as a safe haven for war vessels. The bay of Ajaccio is too wide and open to be protected by marine works, and it is therefore intended to establish a couple of batteries on the hills, separated from each other by a distance of 10 kilom., which, it is said, will be quite sufficient, by their cross fire, to make the port a safe refuge, and will keep a hostile fleet far enough off to prevent its bombarding the town. At Aspretto there will be a battery of 47 mm. quick-firing guns as a precaution against torpedo attacks. Bonifacio is not of much utility on account of the enormous expense that would be necessary for deepening the harbour, and it will therefore be reserved as a station for torpedo boats and submarine boats. It is to Porto-Vecchio, however, that most attention is being paid by the naval authorities. The port is well protected from the wind, and the town is invisible from the sea. A considerable sum will have to be spent for making breakwaters and in dredging work, but it is argued that when this is done the port will be an admirable station for torpedo and submarine boats.

We have already referred to the report of M. Fleury-Ravarin, who, as "reporter" on the naval estimates, acts as a sort of advocate for the ratepayers, and his duty is to cut down expenses and point out improvements which he thinks should be carried out in the various departments of the marine. The sum asked for by the Government is 329,286,699f. This is an increase on the last grant of 14,913,198f. and is due to an augmentation in the number of men and also to an advance in the price of coal, which item alone has necessitated a further provision of 1,300,000f. We may suggest, however, that this increase in the sum paid for coal is to be attributed not so much to the higher values as to the heavy amount of fuel which has been added to the naval reserve during the past few months. M. Fleury-Ravarin reduced the grant asked for by 2,797,169f., but this may be regarded as a purely platonic measure, since the Chamber invariably votes the full amount required by the Government, and, as was shown by the last debate, is disposed to think that the Minister of Marine does not ask enough. In his report M. Fleury-Ravarin, as representing the ratepayers, naturally gives his view upon the programme of the Government, and expresses the opinion that while commerce destroyers have their advantages, pitched battles are inevitable in naval warfare, and battleships are therefore indispensable for naval supremacy. He thus approves of the composite programme, which combines the theories of the two schools. He recommends the Chamber to sanction the project of the Government to put on the stocks in 1901 two squadron battleships, one armoured cruiser, ten destroyers, eleven torpedo boats, and eight submarine boats. The reporter is not sparing in his criticisms upon the present state of the marine, notably with respect to the reserves, which he declares to be entirely insufficient; and, in fact, it is notorious that it would be difficult, if not impossible, to reconstruct adequately a squadron after it had been severely handled in a battle. He is also of the opinion that the French naval power is not properly represented in distant seas. This, again, is a matter which is seriously occupying the attention of naval experts, who find that with the extension of French colonial possessions it is becoming increasingly necessary to have a fleet of cruisers with a wide range of action capable of protecting the colonies. These necessities are growing to such an extent, with the building up of a vast empire, that it is not easy to see where the French are likely to stop in the development of their war fleet. In the same way M. Fleury-Ravarin urges that more rapid progress should be made with the important works being carried out at Bizerta and Dakar, and that the fortifications of Saigon and Diego-Suarez should be proceeded with immediately. The arsenals also need a better equipment. In building docks the French have

been accustomed to provide merely for the largest vessels then afloat, and have not taken into account the possibility of ships increasing in size, with the result that it is a matter of considerable difficulty to find accommodation for docking the biggest cruisers. We believe there is only one port in France which can take the Jeanne d'Arc. Still another matter dealt with by M. Fleury-Ravarin is the difficulty of transferring the marines to the war department, and this presented a great deal of trouble during the expedition to China, when forces had to be sent off at short notice. The marine forces are composed of 70,000 men and 15,000 non-commissioned officers, and with so many formalities to be gone through, their transference to land service is not such a simple matter as it seems. All these and other reforms that are occupying the attention of the Minister show that the Government is bent on carrying out a policy which aims at making the navy as far as possible a homogeneous fighting machine, which may be able to attack or seek refuge in strongly-defended ports as necessity may require. It is true that homogeneity can scarcely be obtained with the existing units but must depend upon the execution of the present programme, and we think that French strategists are relying too much upon any supposed advantage of having their fleet blocked up in impregnable ports. If a fleet cannot escape from its safe haven it is practically useless. Of course, they expect to be able to make things uncomfortable for the hostile fleet by attacks of submarine boats by day and of torpedo boats by night. This is why the creation of "nests" of torpedo boats is such an important feature of the programme, and why, as the result of the recent trials of the Gustave-Zédé in the presence of the Minister at Toulon, the Conseil Supérieur de la Marine is giving special attention to the submarine boat. Fourteen of these boats are either afloat or under construction, and eight are to be put on the stocks next year. The adoption of this definite line of policy in naval construction, the attempt to build a homogeneous fleet with a first line of squadron battleships, swift armoured cruisers, and a small fry of torpedo boats and submarine vessels, the simplifying of the administration so that each department may concentrate its energies on its own special work, and, above all, the fortifying of every home and colonial station which is capable of defence, show clearly enough that the French are profiting from their past errors. The work being undertaken is so vast that it behoves this country to make still further sacrifices in order to maintain her supremacy on the seas.

RAILWAY WAGONS.

In another place will be found an abstract of the paper read on Friday night by Mr. Twinberrow before the Institution of Mechanical Engineers. Mr. Twinberrow has already set forth his views very fully in the correspondence columns of THE ENGINEER. The paper possessed only an academical interest. He proposes changes not only in the construction of railway wagons, but in the whole method of working goods and mineral traffic, so radical, so far-reaching, that they have not the most remote prospect of being carried into effect. None of the speakers found any particular fault with Mr. Twinberrow's proposals. They generally accepted them as sound. Indeed, it was not worth while disputing their mechanical or commercial propriety. There was but one answer possible to the speaker's demands for change—*non possumus*. They were regarded as utterly Utopian. The construction of the wagons proposed was scarcely criticised. In short, it was obvious that only a languid interest was taken in the whole matter. But Mr. Twinberrow elicited and deserved admiration for the way in which he maintained that difficulties were only made to be surmounted, and for the dogged determination with which he upheld the righteousness of his cause.

It is noteworthy that he does not set forth with any particular lucidity the precise amount of the pecuniary benefits to be derived from the use of 30 ton wagons, instead of the normal 10-ton wagon. Indeed, we are disposed to think that, if he had gone deeply into this part of the question, some of his enthusiasm would have evaporated. The paper and much that was said during the discussion showed, in the first place, that there are no satisfactory statements of outlay and income available on which to base an estimate of the value of any particular type of wagon; and, in the second place, that the figures to hand, such as they are, could be used by any speaker to represent almost anything that he pleased. We do not say that all such reasoning as that of Mr. Jones, for instance, was not sound; we do say that his hearers had no opportunity of judging whether it was or not. On all sides, however, it seemed to be agreed that the only proper standard for comparison was the cost of moving a ton of coal or goods of any kind a mile; and this, it was added, was just the kind of information that could not be obtained. Leaving the discussion, however, we may proceed to consider what it is Mr. Twinberrow proposes to do. In so far as we understand him, the whole advantage secured by the adoption of his proposed big wagons consists in a saving of tare. In other words, the dead weight moved would be reduced. It is not difficult to arrive at some idea of what the saving would represent in money. An ordinary coal train in this country weighs about 560 tons, and consists of thirty-five wagons, weighing 210 tons, and carrying each 10 tons of coal. On the Lancashire and Yorkshire Railway coal trains of 1000 tons gross, exclusive of engine and tender, are being hauled daily. Mr. Twinberrow would carry the 350 tons of coal in twelve wagons. What the precise weight of these wagons would be we do not know. His 20-ton wagon weighs about 8 tons. Great Western 30-ton trucks weigh 18 tons. If we say 10 tons for the 30-ton wagon we shall not do his plan an injustice. The total weight of his train would then be 470 tons, or 90 tons less than the normal train. An average resistance of 10 lb. per ton will be high for such a train running at 25 miles an hour, and $90 \times 10 = 900$ lb. as average draw-bar pull required to draw the extra tare. Twenty-five miles an hour is 2200ft. per minute, and $\frac{2200 \times 900}{33{,}000} = 60$ horse-power. Allowing 5 lb. of coal per horse per hour, which is more than enough by far, we have 300 lb. of coal burned per hour. This coal, taking the price of fuel at 10s. a ton, represents about 1s. 4d. The saving, therefore, to be effected, so far, represents about 1s. 6d. per 25 miles run. We do not see how any further saving is to be effected by a reduction in dead weight. The wages of the driver and fireman would remain unaltered. Terminal and all other charges would not be touched. If, on the other hand, we suppose that the load is not reduced, and that the saving only represents more coal hauled in a train of 560 tons, the saving must remain about the same. There is, of course, another phase of the whole proposal which deals with what may be termed facilities of working, by which the capacity of a railway with its yards and sidings is augmented, and augmented with economical advantages. But it is just on this question that the scheme comes to grief. Much more is needed than an increase in wagon capacity. If more were not needed the big wagon would long since have been adopted. There is, in the first place, a diversity of opinion among the best authorities as to which, the big or the little wagon, is best adapted to the wants of the community; but in any case the cost of adapting terminals to the proposed stock would be prohibitive. It is not, moreover, even this great capital outlay that stands in the way so much as the well-founded doubt that any saving would be effected that would pay sufficient interest on the first cost. We have shown that the saving to be effected in hauling 350 tons of coal does not represent one penny per mile. The cost of the normal train of wagons, taking them at £100 per wagon, which is a high price, would be £3500. The cost of a 30-ton pressed steel wagon, made according to American specifications, would be, we believe, £300, and to English specifications about £400. Taking the former figure, it will be seen that nothing would be saved in capital outlay; taking the latter, the cost of the train would be augmented to £4800. It seems to be proved, then, that the entire advantage to be saved lies in the saving to be effected in hauling dead weight. So far as we have been able to ascertain, the number of wagons owned by the railway companies is 634,000, and by private owners 550,000, or, in all, say, 1,185,000, of which about 800,000 are used in mineral traffic. The average capacity may be taken at 9 tons, in equal proportions of eight and ten-ton wagons. But taking the entire number of wagons in the United Kingdom at Mr. Aspinall's figures, viz., 1,167,000, and assuming that these are replaced by one-third of the number at £300 each, we have to contemplate a capital outlay of £116,700,000. Even if we halve this appalling total, we have a sum at which speculators stand aghast. No wonder that the meeting on Friday night did not adopt Mr. Twinberrow's views with enthusiasm.

It is quite indisputable that our present methods of carrying minerals and goods of all kinds, and passengers too, are not the most economical possible. Our railway system represents the growth of half a century. If we could begin all over again to-morrow, under the guidance of a dearly-bought experience, we should manage things differently and much better. This is impossible, and in the old country we must make the best of things as we find them. As the direction which possible improvements may take we shall have more to say perhaps at another time. Mr. Twinberrow might just as well undertake a crusade in favour of replacing the 4ft. 8½in. gauge with the 5ft. 3in. gauge, as that on which he has entered for the reproduction of big wagons. No one would dispute the soundness of his premises or the force of his arguments. It is almost a foregone conclusion that coal can be hauled at a less cost in 30-ton wagons than in those of 10 tons. It is wholly a foregone conclusion that a gauge of 5ft. 3in. or 5ft. 6in. would be much better than the existing gauge. But then neither the one proposition nor the other comes within the scope of practical railway politics.

ELECTRIC EARTH RETURNS.

We have already referred to the general aspects and the main theme of Professor Perry's remarkably able and spirited address to the Institution of Electrical Engineers. We need not revert to his jeremiads concerning our suggested low standard of average scientific and mathematical education. We have in these pages very often expressed our sympathy with the efforts of those who advocate radical reform in our methods of education in the direction of simplifying these methods, making them aim more directly at results useful in the practical business of life, and bringing them more into harmony with modern developments of human knowledge. We heartily wish Professor Perry all success in his crusade against mediæval methods and in favour of the elimination from school and technical teaching of those senseless complexities designed for mental gymnastic training but resulting only in mental disgust and weariness. But towards the end of his address, Professor Perry introduced almost casually a subject the technical and industrial importance of which cannot be overestimated. We refer to the question of insulated or uninsulated electric return currents. It is by no means a new subject, and a glance at its history will help towards a true recognition of the growth of its importance. It first arose in connection with telegraphy, and in this branch of electric industry, under certain conditions, the utility of insulated returns are well understood. In the early days of telephony, so long as there was not very much telephoning going on, no one thought that insulated returns would profit either the constructive engineer or the customer; but as soon as a large extension of telephonic business took place, it was found practically impossible to get on at all without them. In these two departments of electrical work the voltages are very small and the individual currents are minute. The aggregation of large numbers of small currents were found, however, to produce inductive effects destructive to the proper working of the apparatus itself, and the smallness of the utilised effects make the apparatus sensitive to outside influence. With the introduction of electric lighting, engineers were for the first time brought face to face with the effects of high voltage; and dangers, such as fire risks to material and to interests external to the electric apparatus itself appeared. Fire risks and danger to life probably determined at the outset the invariable use of careful insulation throughout the complete circuit in the case of electric lighting. But we presume that from the beginning up to the present no one has been found to argue that in electric lighting work earth returns would be desirable if economy of working were alone to be considered. When Sir William Siemens first applied electric power to the purposes of traction larger currents than were at that time used for other purposes had to be employed, and the idea of saving on first cost by using the earth as a return conductor was a very natural one, especially as no great difficulty presented itself in providing adequate safeguards against accident to limb or life of men and animals, the reason being that no such numerous ramifications of the electrically-charged lines exist with traction as those in electric lighting. So long as electric railways and tramways existed in small number and for very light traffic only, that appeared to be the only thing to safeguard against. It is curious that for electric transmission of power for other purposes than traction earth returns have been little used and seldom proposed.

The question assumes, however, quite different aspects as soon as the business of electric power transmission begins to develop to larger dimensions. First the Post-office complains that they cannot telegraph in the neighbourhood of electric traction lines. That difficulty can be, and ought to be, remedied by inserting insulated returns for all telegraphic lines as in telephony. A common insulated trunk return, serving the whole of the out lines along one route, is all that is needed. If other people are not to have the common use of the earth for completing their electric circuits, there can be no good reason why the Post-office should be given its exclusive use. Then the users of electric and magnetic apparatus in laboratories and observatories for purposes of teaching, research, and record of natural phenomena, complain that their instruments are disturbed. Next, the gas and water companies become more or less restive under the apprehension that their pipes are being subjected to electrolytic decomposition or other deterioration, these people being helped along into the apprehensive mood by the Post-office and the physical research people.

Thus far have we got already, even in this country, where the development of the electric transmission of power still lies all in the future. But what will occur when this certain future development becomes accomplished fact?—when for every ampère now running through a district there will run 1000 or 5000 ampères. All the objectionable results are proportional to the amount of current; they have nothing to do with voltage *per se*, except as regards risk of fire and danger of shock to animals, to both of which dangers we have already long been fully alive and against both of which we already know how to protect ourselves. At that future date not only the Post-office and the observatories, but everybody else will be using electro-magnetic instruments of one or other kind. Such instruments can be protected from external inductive influence; they can be magnetically clad. But if everybody has to protect himself from everybody else, it is only natural that everybody should claim that nobody shall be permitted to wilfully produce injurious effects against which such protection is needed. Everybody's instruments will not be so delicate as the observatory instruments, but the disturbing currents will be a thousand-fold greater. The same may be said of every kind of electro-magnetic machine; every machine is affected by all neighbouring electric circuits whose co-efficient of induction is not reduced to zero. The machine may be clad so as to minimise the disturbing effects of such external inductions; but the need of such protective clothing carries with it the right to demand that no one will unnecessarily produce effects that have to be so guarded against. If your neighbour discharges his sewage under your garden wall you are able, if you like to do so, to take measures preventing this resulting in typhoid in your family; but such possibility produces no inclination to abstain from vigorously protesting against your neighbour's proceedings.

It seems also that the question of actual economy in construction and working expenses combined in regard to this problem of insulated returns, requires, and will receive, more thorough investigation than it has yet received either here or abroad. It is to be noted that no such thing as a pure earth return has ever been attempted in any traction except on a very small scale. From the first the rails, as a more or less continuous line, have been called in to assist the earth. Then the rails were well connected to all the water pipes that could be got at either without the knowledge of their owners or with their permission when that was absolutely required. Then more and more money, and every year a larger offering of labour and ingenuity were expended in copper bonding the rails together and copper connections to every lump of metal that could be reached. The mechanical problem of a really durable copper bonding of successive running rails is a well-nigh insoluble one, and in the endeavour to solve it a cost has been incurred almost sufficient for the laying of a continuous copper strip. Indeed, in many places we already find long lengths of continuous copper strip laid in to help the rails. In tunnel railways, where the constructors started out with the intention to depend on the rails alone,

the invariable result has been that they connect up to the iron lining later on. This is done for the sake of economy; for the sake of reducing the back pressure and increasing the utilised horse-power. And still all these almost frantic endeavours to increase the conductivity of the return, adhere to the principle of an uninsulated earth return subject to the limitations and restrictions imposed by the Board of Trade for the protection of public and private interests. Not long ago, in answer to an advocacy of continuous copper returns, an eminent electric engineer declared that six inches of copper section would be required to take the place of the cross-bonded rails on the line that was being discussed. That was on the assumption that the return was to be still subject to the Board of Trade limit of pressure drop. But no reasonable advocate of copper returns ever dreamt of combining the system with that of earth returns. Nothing but insulated continuous copper returns have ever been proposed by any engineer. The section of such a return does not, of course, need to be greater than that of the out line. If the plates of the iron lining of a tunnel be well and trustworthily bonded together, so as to give a continuous conductivity equal to the whole iron section, then it seems probable that no measurably injurious effects can appear at places outside the tunnel. If the conductivity of the earth between the ends of a line be measured as E when there is no rail or other metallic return to assist it, and if M be the conductivity of any added metallic return running along the same route as that followed by the supply mains, then the disturbing and all other deleterious effects due either to quantity of current passing locally through any spot where the injury arises or to inductive effect, are reduced with practical exactitude in the ratio of (E + M) to E. Making exceptions of tunnels with the iron lining brought into circuit and perfectly bonded from end to end, it seems that the historical trend is all in the direction of insulated returns—whether of copper or iron depends largely on the variation of the ratio between their prices—as likely to be proved to be the eventual economic construction and as likely to be imposed by the law of the land at no very far future date.

We are now about to enter upon a long period of great extension of electric transmission of power. Ought we to start it upon the plan that is likely to be eventually imposed upon us, or should we now try to save a few pounds in cost of construction at the eminent risk of being compelled later on to tear up and re-construct a great portion of our work? The question seems to be one worthy of very serious and frank discussion.

ALUMINIUM PATENTS.

Public notice has been given recently that the British Aluminium Company is about to present a petition to the Privy Council for a renewal or prolongation of Héroult's English patent No. 7426, of May 21st, 1887, which is taken out in the name of A. C. Henderson. This specification would appear to be the master patent under which the manufacture of aluminium is monopolised in this country. It describes two processes—one in which a mixture of cryolite and alumina is fused in a wind furnace, and then electrolysed with a current of three volts to yield aluminium alone; the other in which copper and alumina are fused by electrical heating, and then electrolysed to give aluminium-bronze. Neither of these methods is actually in use at the present time, for the modern process is essentially a combination of them. The wind furnace of the former claim has been abandoned in favour of electrical heating, and the copper of the latter is omitted in order that a pure aluminium may be recovered at the first stage of the reduction instead of an alloy. The superiority of internal—*i.e.*, electrical—heat over external—*i.e.*, coal—firing has often been explained. There is practically no material of which a crucible can be conveniently constructed that is capable of withstanding the necessary temperature without being attacked more or less by the nascent aluminium, so that the metal is almost bound to be contaminated with iron or silicon to a harmful extent. The advantage of winning pure aluminium in place of a copper alloy is obvious; for many of the most important uses discovered for the former would be impossible were it only manufactured in the form of bronze. There is also another objection to the second process, for in it the alumina is actually fused; and as the melting point of aluminium oxide is extremely high, a considerable amount of energy is expended in attaining the temperature requisite. Indeed, in his patent, Héroult stipulates for a voltage of 20 or 25, whereas by the modern plan of dissolving the alumina in molten cryolite, instead of fusing it, a voltage of four or five is amply sufficient to determine reduction as well as to maintain the heat of the bath. Whether the application for a renewal of this patent is likely to be granted is not for us to discuss at this stage of the proceedings; there is certainly a *primâ facie* case in favour of the request, for we believe the manufacture of aluminium by the Héroult process in Great Britain has only been in operation during some five years out of the lifetime of the patent. On the other hand, we may suppose this loss of time may be assumed by the Privy Council to be the patentee's own fault. Such applications are seldom granted in this country—not without justice, perhaps. It has recently been pointed out that the fundamental constitutional idea underlying the grant of letters patent is not to protect the inventor against the public, but to protect the public against the inventor; that is to say, to avoid the possibility of the erection of an ungoverned monopoly, such as did so much harm to the country in days gone by. By this theory a patentee is given by royal clemency certain privileges as a reward and encouragement of his ingenuity and research; and if for any reason whatever he neglects or delays to enjoy those privileges, the fault and the loss are his own.

THE LAW AND TRADES UNIONS.

An important point in connection with the legal status of trades unions was decided in the Court of Appeal on Wednesday. The case arose out of the Taff Vale Railway strike. The railway company brought an action in the Queen's Bench Division against the Amalgamated Society of Railway Servants, Mr. Richard Bell, the general secretary, and Mr. James Holmes, the local secretary of the society, in connection with their action during the strike. The company also took out a summons for an interim injunction, pending the trial of the action, to restrain these two gentlemen and the society from picketing the railway station at Cardiff or any other works or approaches to railway stations, for any other purpose except merely to obtain or communicate information. Mr. Justice Farwell, before whom the matter came in September last, granted the injunctions asked for, and refused, in answer to a counter summons, to strike the Amalgamated Society of Railway Servants out of the action, and granted an injunction holding that the society could be sued as a body. The society hereupon appealed, and the case came into court on the 12th inst., and was argued at length, judgment being reserved. It is unnecessary for us to go into the arguments adduced on either side. These were clearly summed up by the Master of the Rolls, when reading the decision of the Court on Wednesday, as also was the judgment of Mr. Justice Farwell. The Master of the Rolls said the matter resolved itself into the question whether there was any statute which specifically stated that trades unions could be sued as bodies. He could find nothing in the Acts relating to such bodies from which the inference was to be drawn that the Legislature has enacted that a trade union can be sued in its registered name. Indeed, by reason of the language of the Acts he finds the exact contrary, and for these and other reasons enumerated at length in a written judgment, the finding of the Court was that a trade union cannot be sued as attempted in the present action. The result, of course, is that so far as the present judgment is concerned, the Amalgamated Society of Railway Servants disappears from the action. It seems to us, however, that the railway company is most likely to take the matter to the House of Lords. It is hardly likely that, having gone so far, it will submit to the judgment of the Court of Appeal without going still further. It is a most important point which is involved, and it is unsatisfactory, to say the least of it, to have only two judgments, and those antagonistic to one another. A railway company is not a philanthropic institution which seeks to improve the general condition of affairs. It has to consider its shareholders' interests from all points of view. We trust that it may be found consonant with these interests that the matter should go to the House of Lords. Leave to appeal has, we understand, been asked for and obtained.

THE NORTHERN RAILWAY OF RUSSIA.

The project of constructing a Northern Railway has been for some time before the public in Russia. Unfortunately, this project was bound up with the abortive Moscow-Yaroslav-Archangel Railway. When the latter railway came to grief, and M. Mamontoff and his associates were lodged in prison, the line became the property of the Imperial Exchequer, and passed under its control. This resulted in the former shareholders of the line giving up the construction of a Northern Railway. However, of late these shareholders seemed to have taken up the idea again, and it is now reported that they are trying to obtain the concession to build this long-projected railway. Well-informed circles in Russia ascribe this sudden resolve to foreign influence. Several foreign syndicates have already expressed their readiness to carry out the construction of the line from St. Petersburg to Viatka, 280 miles N.E. of Nishni-Novgorod, and at the same time to undertake the working of the Moscow-Yaroslav-Archangel group of railways. The applicants for the necessary concession include a group of American capitalists, and it is their intention to make the projected line a main line between the Baltic and the Siberian Railway, as such a line would naturally be of immense economic importance. It is said that the line will be laid in the shortest possible direction, as it is hoped that the corresponding saving in time will attract a considerable portion of the traffic which at present goes to the Far East either by the Suez Canal or by the Canadian overland route. If these far-reaching projects are carried out, the port of St. Petersburg may be called upon to play an important part; but it will be necessary to raise that port at least to the level of the Baltic ports. Northern Russia itself will not be greatly benefited by a main line, which is to be laid down exactly as the line was built from St. Petersburg to Moscow. When the surveyor of the Moscow line approached the then reigning Tsar as to the route to be taken, the monarch said there could be but one route, and, taking a foot-rule, he drew the shortest possible line between the old and the new capitals of his empire. Thus the Moscow Railway runs for 404 miles, and carefully avoids the few towns that could easily have been taken in by the railway. However, when once this Northern Railway is built, it will be a question of constructing branch lines for the benefit of the neglected region. According to the present project the Northern Railway is destined to serve more important ends than those of a district which is relatively much smaller than the immense region beyond the Urals now awaiting development.

RAILWAYS IN THE BALKANS.

The question of railway construction in the Balkans is being followed with the deepest interest by the Russian Press. Of course, this interest is displayed solely from a desire to ascertain how far the construction of railways in the Balkans may be expected to favour or clash with Russia's designs in that region, and not from any kindly interest in the development of the Balkans. The *Rossija* now comes forward with a proposal to build a cheaper and more convenient line of railway for the Balkan people than the line projected to be built through Austria. If this cheaper line is built from the Danube to the Montenegran port of Antivari, on the Adriatic Sea, starting at Negotina in Servia, then all the Balkan States would be made independent of Austria. By this line Roumania would be 400 miles, Servia 267 miles, and Bulgaria 367 miles from Antivari. Apart from the fact that this line would be shorter and more convenient, Antivari would be a very suitable port for exporting the products of the Balkan States. The construction of a line of railway from 340 to 400 miles in length would thus serve to set free the hands of Servia, Roumania, Bulgaria, and Montenegro. The *Rossija* claims that Russia must have a share in the execution of this project, seeing that the line would benefit Russia. From the Black Sea to Antivari the distance would be about 670 miles, or a journey of twenty-four hours, and from the Russian frontier across Roumania the distance would be 735 miles.

REJECTION OF AMERICAN STEEL SHIP PLATES.

The fact of a consignment of steel ship plates to Glasgow merchants from America having been condemned after delivery to the users—Workman, Clarke, and Co., of Belfast—has been much discussed in trade circles in Glasgow and elsewhere, and some erroneous impressions have been created in connection with the matter. The plates were supplied by the Lukens Company, Coatesville, and not by the Carnegie Works, as stated by some reports. The rejection of the plates really arose more from a technical inadvertence than from any radical defect in manufacture. Pressed very persistently to give delivery at earliest possible moment, the Lukens Company, after severing the test pieces, actually allowed the plates to leave the works before Lloyd's official had arrived to conduct the testing. When he did arrive, and found that he was expected to take for granted that the test pieces presented to him were those from the plates not actually before him, he refused to proceed with the tests. Afterwards he was induced to proceed, and, as it happened, several of the pieces were found deficient in some of the test results. In the circumstances, this was sufficient to cause the condemnation of the whole. Word was sent in accordance to the merchants and users on this side, but not before the Lukens Company, with the business promptitude which characterises the Americans, had put in hand a repetition of the whole order. The circumstance, however, is bad enough for the Americans, and will doubtless put a check on the ready acceptance of steel from the States by home merchants and users. The vigilance and firmness of Lloyd's official in this case will also redound to the credit and standing of this registry society—in America probably quite as much as in this country.

RUSSIA IN THE RED SEA.

In spite of the fact that the German Press has published a denial of the report that Germany has acquired a coaling-station in the Red Sea, the *Viedomost* reproduces, without any reserve, a letter received from its correspondent at Aden to show that the acquisition of one of the two Farsan Islands, on the eastern side of the Red Sea, is an accomplished fact on the part of Germany. The correspondent confesses that the Farsan Islands suffer from certain drawbacks, seeing that they possess no fresh water supply, and are almost uninhabitable; but he declares that Germany will, nevertheless, not repent having taken this step, and he calls upon Russia to imitate its example. "Every Power standing in any way in connection with the Far East, including even Italy, which has no interests in that remote region, possesses coaling stations between the Suez Canal and the Arabian Sea; but Russia alone has no such stations. Alike in the Red Sea and in the Persian Gulf Russia must acquire a 'privileged position' in its own interests. This step admits of no postponement, since any delay can lead only to the result that instead of a rather harmless competitor in the shape of Great Britain, another and stronger competitor will arise in Germany, which, by reason of its increased colonial interests, will find it necessary to look out for naval supporting bases in Persian and Turkish waters."

GEORGE FREDERICK ARMSTRONG.

The death is announced of Professor George Frederick Armstrong, of the Chair of Engineering in Edinburgh University. He died at his home in Grasmere, Westmoreland, on the morning of the 16th inst. He had had a serious illness a few years ago, and during the last three months having suffered much from his heart, leave of absence had been accorded him until Christmas. Professor Armstrong was born at Doncaster in 1842, and received his general education at Jesus College, Cambridge. Having developed a strong taste for mechanical pursuits, he was educated professionally in the Engineering Department of King's College, London; in the locomotive and rolling-stock works of the Great Northern Railway; and in the office of the engineer-in-chief of that company, Mr. R. Johnson, M. Inst. C.E., on whose staff he was subsequently employed for several years in connection with the design and execution of important works, and generally in the maintenance of the line. Afterwards he took up private practice in London, and in 1868 became engineer to the promoters of the Isle of Man railways, for whom he made all the requisite plans and surveys, and prepared designs for ways and works and for the necessary rolling stock in connection with the lines then projected. In 1871, having taken up the teaching art, he was elected first professor of engineering in the new Applied Science School at the McGill University, Montreal.

Five years later he re-crossed the Atlantic to engage in similar work in the Yorkshire College of Science, Leeds, and in 1885 was appointed by the Crown to succeed the late Professor Fleeming Jenkin as Regius-Professor of Engineering in the University of Edinburgh. This important post he filled with acceptance till his death, and he was also engineering adviser, under the Public Health Act, to the Local Government Board for Scotland. From an early date Professor Armstrong took an active part in the promotion of technical education at home—his inaugural address at Edinburgh having been mainly concerned with this subject—and in the Colonies as well. By intimately associating himself with the work of promoting and organising the two Edinburgh International Exhibitions, 1885 and 1890, in the latter of which he was convener of the Engineering and Machinery Committee, and vice-chairman of the Executive Council, he indirectly, if not directly, rendered good service in the cause of industrial enterprise in the East and West of Scotland. He was president of the Sanitary Engineering Section of the British Institute of Public Health in Edinburgh in 1893, and delivered an address, and in connection with the last meeting in Edinburgh of the British Association he acted as secretary, and in a similar capacity at the Edinburgh meetings of the Institution of Mechanical Engineers and of the Iron and Steel Institute. During the summer and autumn of 1879 he undertook an elaborate series of observations and experiments with a view to determining the diurnal variations in the amount of carbon dioxide in the air, the results of which were communicated in a paper to the Royal Society of Edinburgh, and have since been extensively accepted as constituting a standard of reference. In 1889 the Council of King's College elected Professor Armstrong to the Fellowship of the college, the highest distinction the college is empowered to bestow on its alumni. He was an examiner for science degrees in the departments of engineering, public health, and agriculture in the University of Edinburgh, and a member of most of the professional institutes and societies. He took a keen interest in educational affairs; taking a lively share as well in the social life of the University, and was a great favourite with the general body of students. He is survived by a widow, one daughter, and three sons.

The contract for the construction of the new American yacht Defender has been placed with Herreshoffs.

DOCKYARD NOTES.

THE *Cronstadt Vestnik* says that the crews of the ironclads Poltava and Sevastopol, and of the sea-going torpedo boats Ssom, Kit, and Dauphin, which have recently been fitted out for the Pacific squadron, will number in all 72 officers and 1527 men. The total number of guns carried by the above-named vessels consists of 138 of various calibres. The Russian Pacific squadron will moreover be strengthened in the near future by the addition of the ironclad Peresviet, the first-class cruisers Gromoboi, Pallas, and Variag, the torpedo cruisers Amur and Yenissei, and by the torpedo boats Ossetr, Forelle, Kefal, Lossos, and Sterliad. This increase of the Pacific squadron will represent an addition of 143 officers, 3206 men, and 262 pieces of artillery.

THE Higher Council of the Italian Navy has approved the new type of warship proposed by M. Morin according to the designs of M. Cuniberti, colonel of naval engineers. The new warship will have a displacement of 12,000 tons, and its armament will consist of two guns of 30 cm. fore and aft, of twelve guns of 20 cm. mounted upon breast turrets, of twelve guns of 7 cm., and of twelve guns of 5 cm.

THE *Cronstadt Vestnik* announces that a start will soon be made at Nicolaieff, on the Black Sea, with the construction of an ironclad, with a displacement of nearly 13,000 tons. The length of the projected vessel is to be 390ft., and her engines, of 17,000 indicated horse-power, have already been ordered from the Sormoff Works. The rate of speed to be attained has been fixed at 18 knots an hour.

THE torpedo destroyers Ossetr, Kefal, and Lossos, which are now being built for the Russian Government by the French shipbuilding yard Forges et Chantiers de la Méditerranée, will not be ready before next year. Each of these destroyers will be 185ft. in length, 19ft. in beam, and with a draught of about 10ft.; their displacement will be 312 tons. The engines will be of 4750 indicated horse-power, and will give a speed of 26 knots an hour. Each destroyer will cost nearly 500,000 roubles, or about £51,500.

THE announcement that Mr. Holland, the inventor of the submarine boat, is building a boat in which he intends to cross the Atlantic, betokens a daring rather than a useful feat. The fact of the matter is that the question of submarines acting away from their base needs no demonstration. It is obvious that they can be carried on ship board. As Mr. Holland's new submarine will be convoyed by a steamer, the experiment cannot throw much light upon the question of a submarine's ability to act alone. Even if no use is made of the steamer, she will still be at hand in case of need, and the knowledge of that must count for a good deal with the occupants of a boat. Given the ability to carry the necessary stores, there is, however, nothing to prevent a boat making such a voyage. If the weather is bad, she has merely to go below. If the new boat is like the old one in the matter of the crew having to retain fixed positions when submerged—and we presume that this cannot be avoided—some of her crew of eight stand to get fairly stiff if much being submerged is necessary, but probably it will not be as bad as sea-sickness. The voyage, if successful, will be a splendid advertisement for submarines.

WE much regret to learn of another disaster in the Japanese navy, again off the Chinese coast. The lost vessel is the Katsuragi, a ship on a par with our Active and Volage, though a good deal smaller. She was launched at Yokosuka in 1885; displacement, 1500 tons; armament, two 16 cm. and five 12 cm. Krupp guns. She was the first twin-screw ship in the Japanese navy; a one-funnelled, barque-rigged craft, with a ram bow. Her value as a fighting ship was, of course, nil.

THE engines of the Japanese destroyer Niji have been salved, and a new hull is to be built for them at Yokosuka. She will then be the second destroyer that tends to approximate to the Irishman's gun—the other being the Argentine Santa Fé. This boat was also totally wrecked, but her engines were fished up and sent over to Yarrow and Co., Ltd., who soon added the missing hull. In the good old days it used to be a regular custom to re-build a ship once every 100 years or so. The champion vessel this way was one of the Resolutions—the first—which under various names existed for nearly 200 years, thanks to several re-buildings.

THE Spartiate got through her first trial splendidly, but on the second, as we briefly announced last week, something went wrong. Various reports concerning hot bearings and so forth are about. The latest says that it will take six weeks to put her machinery right. She will certainly not be added to the British fleet this year.

THE Glory, when leaving Portsmouth Harbour on Monday, caused a good deal of excitement by refusing to steer. The explanation is that steam had been shut off from the steering gear—certainly an all-sufficient reason.

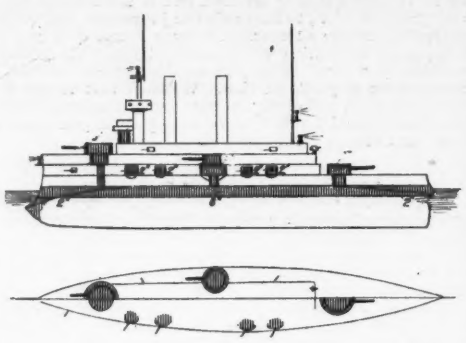
THE Japanese battleship Hatsusi has arrived at Chatham, or will have arrived by the time these lines are in print. Report sent her there a good three weeks or more ago. She will not go to Portsmouth or Southampton on her way to Japan. The Mikasa is expected at Portsmouth next June or July to dock and complete for sea.

THE Italian destroyer Dardo, one of a quartette constructed by Schichau, is more or less a sister to the Taku class, as China's four destroyers have been named by their captors. We hear from China, by the way, that, short as was the time the Chinese had these boats, they had managed to reduce the speed from 80 to 90 per cent., and that months of labour will be needed before they will be able to steam at anything like the original speed. Some confusion in the Celestial mind between feed pumps and mud dredgers seems to have been the prime cause. From the same source we get a rumour that the erstwhile 24-knot cruiser Hai Tien, perhaps the best example of an Elswick cruiser, is in limbo altogether, as some one in the engineering department had drawn his pay in kind—the kind consisting of any portable essentials in the machinery. Had the Hai Tien been kept in working order, not a single cruiser could have caught her.

THE Japanese cruiser Yayeyama is to be experimentally fitted with Niclausse boilers of the latest pattern. This is a decided "leg-up" for the Niclausse firm, who no doubt will be able to follow up the lead. They cannot—as our correspondence column recently witnessed—be accused of a tendency to hide their light under a bushel, saving always in the case of the Seagull. The fitting of that ship with Niclausse boilers was a pure farce, and it is curious that such a carefully-arranged condemnation should have caused so little protest; for the fitting of the Seagull with the most antiquated type of Niclausse boiler practically spells nothing else.

THE British Admiralty have, however, a taste for antiquated patterns for experimental purposes. It may be remembered that we drew attention to the fact that the Barr and Stroud transmitters fitted experimentally to the Canopus are not by any means the latest pattern. A semi-official explanation was forthcoming to the effect that the instruments were purchased a good while before being fitted, hence their relatively antiquated pattern. No explanation of this sort, however, covers the fact that Japan and Russia both use them, while we still experiment. The experiment has gone on now for a good twelve months, and gunnery officers are growing impatient. If one thing is clearer than another it is the absolute need of instruments to convey the range instantly from the range-finder to the guns.

No ship has had a more adventurous career than the Russian coast defence battleship Admiral Butakoff. Years ago she was a sister to the General Admiral Graf Apraxsin, then she became a dummy never intended to exist, then a cruiser of the Bayan type, and now, finally, she turns up as a new type coast defence battleship of 6000 tons. According



to latest report she will be a very reduced Tsarevitch—two 8in. guns forward in a turret, two aft, and one each side amidships, with an armoured tertiary battery—this last being a feature of all new Russian designs. The accompanying plan will give some idea of her, but details are, of course, liable to change.

INTERNATIONAL ENGINEERING CONGRESS, GLASGOW, 1901.

A CONSIDERABLE portion of the address delivered by Dr. Robert Caird, president of the Institution of Engineers and Shipbuilders in Scotland, on October 23rd, consisted of a statement as to the progress which had been made in arranging for and organising the Engineering Congress to be held in Glasgow during the currency of the International Exhibition in that city next year. The Special Committee appointed by the Council of the Institution, rather more than a year ago, immediately set about studying the question of the best form, in view of all the circumstances, to give to the Congress. They visited London and attended several conversazione and summer meetings, notably those of the Institutions of Civil and Mechanical Engineers, and consulted many of the leaders in such movements. The idea of a Congress in Glasgow during the Exhibition year was, in almost every instance, very favourably received. They were led to realise that it was of vital importance to secure, at all events, the moral support of the Institution of Civil Engineers from its position as the *doyen* of engineering societies, and from its somewhat peculiar position as a sort of synthesis of the leading members of almost all the other societies. The Council of that Institution, from the first, took up a favourable attitude. Sir William Preece, the then president, in opening the conference in 1899, made an appreciative reference to the proposed Glasgow conference, commending it to the members. The Council accepted the proffered invitation to its president, who should then be in office, to act as president of the Congress; and Sir Douglas Fox, has consented to act as chairman of the London Committee.

Lord Kelvin is the honorary president of the forthcoming Congress; the president will be the president then in office of the Institution of Civil Engineers; the chairman of the London Committee, Sir Douglas Fox; and the chairman of the Local Committee, Dr. Caird himself. The work of the Congress will be arranged in nine sections, each representing a distinct department of engineering. Each section will have a chairman and secretary, appointed by the society in charge of it, and they will make all arrangements in connection with the reading of papers, the discussions, and the general business of the section, with the assistance of the General and Local Committees. The ruling idea has been to leave the Institutions in charge of sections as free in the conduct of the business as if they were holding independent summer meetings, merely grouping them together in a kind of federation cemented by a series of receptions and entertainments. Each section will, of course, be at liberty to publish the papers read in its own "Transactions." It is not intended to publish bulky "Transactions" in connection with the Congress, but rather short abstracts, with, perhaps, an occasional paper *in extenso*. The nine sections referred to are:—I., Railways; II., Waterways and Maritime Works; III., Mechanical Engineering; IV., Naval Architecture and Marine Engineering; V., Iron and Steel; VI., Mining Engineering; VII., Municipal Engineering; VIII., Gas Engineering; IX., Electrical Engineering. Section I., Railways, will be under the chairmanship of Sir Benjamin Baker, a past-president of the Institution of Civil Engineers. The secretary is Mr. R. Elliot Cooper. Of Section II., Sir John Wolfe Barry, also a past-president of the Institution of Civil Engineers, will be chairman, and Mr. L. F. Vernon Harcourt, secretary. The latter has already completed his programme of papers for the meetings of his section, and it will shortly be issued. It is essentially an international one, and contains important papers by eminent engineers in various countries of Europe and America. In the case of Section III., Mechanical Engineering, negotiations with the Institution of Mechanical Engineers are still proceeding, but as the result of a meeting recently held with the Council, under the presidency of Sir William White, matters are expected to be expeditiously arranged. For the section of Naval Architecture and Marine Engineering, the Institution of Naval Architects are under invitation to assume charge, and this they can the more readily undertake in view of the fact that they had already, on the invitation of the Corporation of Glasgow, arranged to hold their ordinary summer meeting in Glasgow. Sections V. to VIII. inclusive, have been placed in charge of the Iron and Steel Institute, the Institution of Mining Engineers, the Incorporated Association of Municipal and County Engineers, and the Institution of Gas Engineers; and Section IX. will be under the charge of the Institution of Electrical Engineers. The Corporation of the City of Glasgow has formally intimated its intention of receiving and entertaining the members of the Congress, and the Court of the Glasgow University has offered to place the University buildings at disposal for the meetings of the sections and the accommodation of the Congress as a whole. Such surroundings, it is felt, will add greatly to the dignity and interest of the proceedings, and will prove no small factor in the success of the Congress. A large guarantee fund for the purposes of the Congress is being subscribed, and in the words of Dr. Caird, the Congress as organised promises to be one of the most important that has ever been held in this country.

SOUTHWOLD SEWAGE EXTENSIONS.

WE understand that the Local Government Board have just sanctioned a loan for thirty years for the construction of anaërobic beds and bacteria oxidation polarite filters for the treatment of the whole of the sewage of Southwold, also a loan for twenty years for the erection of a small refuse destructor.

We believe this is the first time the Local Government Board have approved of a scheme for the bacterial treatment of sewage and filtration of effluent without imposing any restrictions and conditions. This being so, our readers will no doubt be interested to know of what nature are the works which the Southwold authorities are about to carry out.

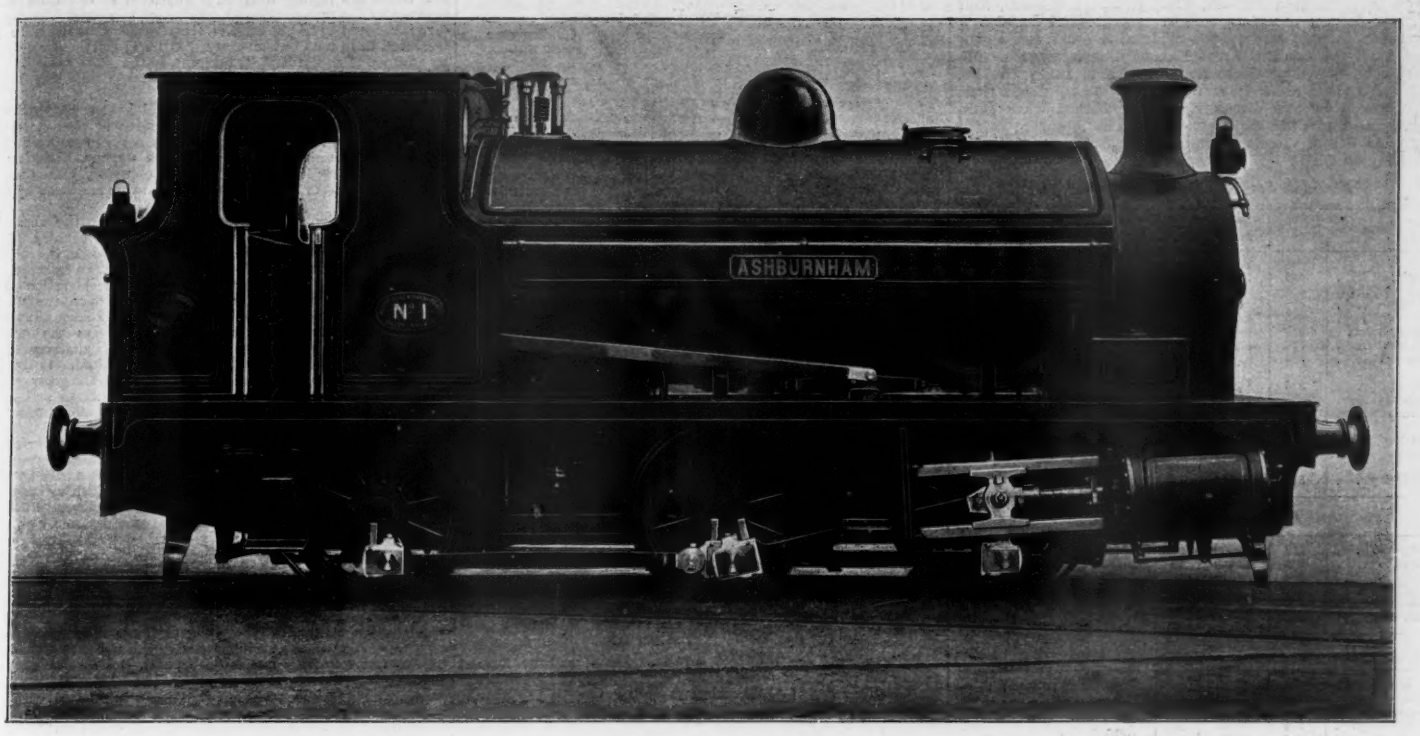
An installation has been under the supervision of the borough engineer—Mr. F. Ball—for about a year and a-half, during which time it has proved not only to be very economical but highly efficient. The following is a short description of the proposed works:—The sewage on entering the works flows into detritus chambers and thence passes under suitably-arranged divisional and scum boards and through a self-cleansing inclined screen. It next enters the two primary anaërobic bacteria beds, where it is evenly distributed by means of rows of 4in. pipes laid with open joints. Passing through the beds, the effluent is collected near the surface by means of suitably-arranged troughs, delivering into a main trough in each bed, provided with an outlet valve and pipe, each of which delivers into the bottom of one of the two secondary anaërobic beds, wherein it is evenly distributed by means of 3in. pipes laid with open joints, the effluent being collected at the surface by branch troughs which deliver into an outlet or storage trough.

The outlet or storage troughs from each of the two secondary anaërobic beds deliver into a valve box provided with automatic intermitters, which, when a certain volume of effluent equal to three minutes' flow has been stored in the troughs, automatically discharges the stored volume, plus one minute's flow, into each of the two automatic revolving distributors in the space of one minute, which sprinkle the effluent over the surface of the polarite bacterial oxidation beds, giving three minutes' rest for aëration out of every four minutes, which is equal to eighteen hours' rest out of the twenty-four. The objects of the intermittent supply of effluent to the beds are stated to be as follows:—First, that by delivering comparatively small quantities in the beds with short intervals of rest, the aëration of the beds is more complete, and consequently a higher degree of purification of effluent is obtained than by thoroughly deluging the beds and giving longer intervals of rest. Secondly, that better results are obtained by sprinkling than by continuous distribution. Another important advantage of the intermittent system is said to be that it prevents any growth on the surface of the aërobic beds. The effluent is collected from the bottom of the two polarite aërobic beds by drains connected to a master channel which discharges into an effluent inspection chamber, from whence the effluent flows through the outlet pipe into the Buss Creek, a non-navigable tidal creek. The town is sewered upon the separate system, while the water consumption is small; the consequence being that the sewage is exceedingly strong.

DOES BRITANNIA RULE THE WAVES?—In answer to the suggestion that we have lost our supremacy through the silent acquiescence of the Government, it may be well to examine a little more carefully what we have done and what we are doing. The Navy List for November contains the names of twenty-six armoured ships, of a minimum displacement of 9800 tons and a maximum of 15,000 tons, now under construction, and within the last few days orders for six more ships have been placed. This is not a projected programme, but a concrete entity, and we doubt if any three other Powers combined can produce such a record of activity. Whether the resources of the country are equal to such a colossal production within an average period of four years remains to be seen, but it is certain that no two other Powers can at present undertake it. Let us see what we have done since the passing of the Naval Defence Act, and for guidance we rely solely upon the *Naval Annual* for 1900. We have adopted this standard because it fixes a comparatively recent date when the lists of the world's ships underwent careful revision, and because an easy means is found for checking our accuracy. There have been fluctuations since the publication appeared, but as these affect one Power quite as much as another they are immaterial to the argument. We find, then, that at the time of the last reivison of the lists Great Britain had built, or was building, 39 battleships, 13 armoured cruisers, and 106 cruising ships, making a total of 158. France's contribution was 24 battleships, 18 armoured cruisers, and 37 cruising ships, total 79. Russia has built, or was building, 23 battleships, 8 armoured cruisers, and 19 cruising ships, total 50; giving Great Britain a nominal superiority of 29 ships.—*Naval and Military Record*.

SADDLE TANK LOCOMOTIVE, BURRY PORT AND GWENDREATH VALLEY RAILWAY

MR. R. A. CARR, ENGINEER



SADDLE TANK LOCOMOTIVE.

We illustrate above the saddle tank locomotive Ashburnham, recently built by Chapman and Furneaux, successors to Black, Hawthorne, and Co., Limited, of Gateshead-on-Tyne, for the Burry Port and Gwendreath Valley Railway, South Wales. The line extends from Llanelly to Cwm Mawr, a distance of about seventeen miles, with several branches, and is used for conveying the heavy mineral traffic from the collieries *en route* to the shipping tips at Burry Port. To meet the occasional, and in one or two places severe, gradients of 1 in 45, 1 in 57, 1 in 63 on the line, an engine of high tractive power is necessary, and we understand this engine is capable of hauling loads of 253 tons up the first-named bank at an average speed of eight miles an hour. The main dimensions are as follows:—

Gauge of railway	4ft. 8½in.
Cylinders, diam.	1ft. 4in.
Stroke of piston	2ft.
Diameter of wheels over new tires	3ft. 8in.
Thickness of new tires	3in.
Wheel base, fixed	5ft. 8in.
Wheel base, total	12ft. 9in.
Heating surface—tubes	850 sq. feet.
" " fire-box	78 sq. feet.
Total	928 sq. feet.
Grate area	14 sq. feet.
Working pressure	140 lb.
Capacity of tank	950 gallons.
Capacity of bunker	27 cwt.

The trailing axle is fitted with the builders' special arrangement, which allows ¾in. side play per axle-box, or a total of 1½in. for the axle to enable the engine to traverse the sharp curves, of which there are a few on the line, with ease, and the trailing side rod is fitted at the driving crank pin with a swivel joint to allow the freedom essential for the side play of the axle-boxes. The boiler is fed by two of Gresham and Craven's No. 7 combination injectors, and has the usual complement of mountings. The engine is fitted with both the Eames vacuum and hand brakes acting on all the wheels, either independently or in combination. We understand the engine is giving complete satisfaction to the engineer and locomotive superintendent, Mr. Robert A. Carr, to whose specification it was designed.

LABOUR TROUBLES.

The management of Penrhyn Quarries having given notice that the quarries will be open on two days for the usual monthly accounts to be given up, and further intimates to customers that they cannot undertake fresh contracts in the present unsettled state of things; the impression is strong in the district that a lock-out is intended.

On Thursday several contracts were refused, and though the management exhibited a conciliatory spirit, a good deal of friction was shown by the men, and a mass meeting on Monday brought this out very forcibly. Mr. W. H. Williams spoke at length, strongly advising the men to be judicious in their course of action, and to take time to consider the matter, but no decision was agreed upon, and the condition of things is regarded as doubtful. Latest news is slightly more favourable.

During the past week a strike has existed at the Frongoch lead mines, near Aberystwith. For some time the Belgian company working these mines have employed a large number of Italians, with an equal force of Welshmen. At the time of the outbreak there were 200 Italians and 250 Welshmen employed, and the friction between the two parties was so strong that a force of police was sent for, and these had to guard the foreigners to and from the mines. The Welshmen had many complaints, but the prominent one at the time the strike occurred was undue preference given to the Italians. For instance, they were allowed to work on Saturday afternoon, and even on Sunday. They also worked on "Mabon's day," which the Welshmen kept. Against this it was urged that the foreigners observed their saints' days, which the Welshmen ignored. Active measures are being taken to bring about peace, and at the latest date prospects were more assuring.

A large meeting of signalmen employed on the Brecon and Merthyr Railway was held at Dowlais on Sunday, attended by men from all parts of the line and its connections. The object of the gathering was to discuss alleged grievances, and this was done by various speakers. Eventually it was decided, first, to demand that the signalmen should be granted the same advantage and privileges as the signalmen of other lines. It was also agreed that no proposal should be accepted dealing with individual cases, and failing a satisfactory reply from the management, to appeal to the directors.

An impression prevails that the movement is one in sympathy with the general unrest of the railway world. Mr. Gall, the chief manager, has had a life-long connection with the line, and personally is held in great respect for his consideration of the needs of his employés.

Railway men over a wide radius are up in arms at the dismissal of Unwin, the signalman, by the Great Eastern Railway Company. On Sunday a mass meeting was held at Stratford, when the following letter was read from Mr. Bell, M.P., secretary of the Amalgamated Society of Railway Servants:—"I very much regret that, in consequence of having to attend another important meeting out of London on Sunday, I shall be unable to be present at your meeting in order to express my strongest indignation at the autocratic and coercive action of the Great Eastern Railway Company. Seeing that the directors of this company have as their chairman a member of a well-known autocratic family, it is scarcely to be wondered at that they should adopt such coercive methods with their employés—treatment different to that of all railway companies, without exception. The powers of employers over their workmen are in many instances most unfair, in my opinion, but when, as in the case of the Great Eastern Company, they deny a citizen's rights to their employés, they go a step too far. If I am not mistaken as to the material of which the Great Eastern men are made, they will not tolerate this very much longer. I am one who has done, and will continue to do, all in my power to prevent strikes and disputes between employers and employed. In the case of the recent disputes, and also many previous ones in connection with hours and wages, there is room for compromise, and with a little forbearance on the part of both sides a strike may be avoided, as was done in the case of the recent Great Eastern Railway agitation. But with regard to a railway company dictating to its employés what they shall do, and where they shall go, after having completed their turns of duty, that is a matter in which there is no room for compromise—it is a thing which absolutely cannot be allowed. My own conclusion on the matter is this: Lord Claud Hamilton, whose family representation is so well known, is such a political autocrat that if anyone does not believe his faith, and support his ideas, he must coerce them. We should not forget his action in 1899, when he threatened to withdraw his support from the Government because they contemplated doing something in the direction of securing protection for the lives and limbs of railway men. It would now appear that, fearing some of the Great Eastern Railway employés might vote on the Local Council against his opinions, they are either to be coerced to resign from the Council or lose their employment. This is not a question of hours and wages, it is a question of every man's civil rights—the rights granted to him by the State, and it is every man's grievance. I would recommend that a thorough agitation be commenced, that the men appoint a deputation to seek an interview with the directors of the company to demand their civic rights and liberties, and that failing a satisfactory result of these efforts, other measures should be seriously considered. To be tied to the Great Eastern Railway body and soul, and to be deprived of their citizen rights, is more than the men can be expected to tolerate. I hope you will have a very successful meeting, and that something will be done to combat Lord Claud Hamilton's tyranny.—Signed, Richard Bell, Gen. Sec." A great number of representatives of trades societies were present and numerous energetic speeches were made, and at the conclusion a resolution was unanimously passed requesting the company to reinstate Unwin and to rescind the offending rule.

On Sunday evening Mr. Bell addressed a large meeting of railway men at Swansea, and advocated the necessity for a thorough organisation to resist encroachment on their rights. The railway companies had a great organisation to protect themselves, and it was essential that the men should be similarly supported. There were 67 railway directors in the House of Commons. In the course of his address he stated that for the last three or four years railway companies had enjoyed prosperous times, but he predicted that depression would come again. The day would come when men thrown out of employment would compete with railway men, and organisation was imperative.

A mistaken impression prevailed and had wide currency in the South Wales colliery district last week, owing to Crawshay and Co., Cyfarthfa, having taken out summonses against twenty-six of their colliers for abstention. This at once started the rumour that Cyfarthfa was taking the initiative in prosecuting the colliers for not working on Friday last, and that in all likelihood sections of the 100,000 colliers who had taken holiday would be proceeded against generally. The rumour was soon set at rest, and on Monday the correction was officially verified by the true statement of the case in court. On that day the twenty-six colliers were charged for absenting themselves from work on the 6th and 7th inst. It appeared from the prosecution that the men were a section of the 400 day men employed at the Castle colliery. The shaft was a wet one, and mechanical arrangements were made to drain the water, and a bonnet had been fixed over the cage to protect the men from the spray. A leakage, however, still continued, and the men, finding this, abstained from work. Then still more careful measures were taken and leakage totally prevented, but the men still refrained from work. The prosecuting counsel suggested that this was part of the scheme for reducing the output and maintaining the high wages prevailing, but the magistrate ruled him out of order, and pointed out that it was a case open to settlement, as up to a certain point some plea of justification was tenable. By direction of the magistrate the contending parties withdrew, and eventually an agreement was brought about, the men paying part of the costs—2s. and 5s. each man.

The lightermen's dispute continues to have a disastrous effect on the business of the port of London.

A difficulty with twenty-eight locomotive men of the Tredegar Iron Company has been settled. They abstained from work without notice on the 15th inst., and summonses were issued. On Monday the prosecution applied to have them withdrawn, the men having expressed their regret and returned to work.

The bulk of the Penrhyn Quarry strikers decided to return to work on Wednesday, after a fortnight's holiday. This week the sixteen men charged with assault will be tried. For the present the military force remains in the district. On Tuesday there was a crowded mass meeting held, when, for a time, the resolution to resume work was opposed, a counter proposition being to march upon Bangor upon the morrow, but eventually the resolution to go to work was carried.

The report of Major-General C. S. Hutchinson to the Board of Trade, in reference to the collision which occurred on August 25th at Sandhills No. 2 cabin, near Liverpool, on the Lancashire and Yorkshire Railway, has been issued. Major-General Hutchinson has arrived at the conclusion that the collision was caused by a mistake on the part of Signalman Francis Moran in giving permission for the Midland train to approach the home signal of Sandhills cabin No. 2 while the Lancashire and Yorkshire train from Leeds was standing at it. Considering the importance and busy nature of this part of the Lancashire and Yorkshire system, and the number of block instruments and signals to which the signalmen have to attend, particularly in Sandhills cabin No. 2, Major-General Hutchinson says it is desirable that special means—such as are now becoming common on many of the principal railways—should be adopted for, as far as possible, preventing a signalman from making such a mistake as led to this collision.

NAVAL CONSTRUCTION IN THE UNITED STATES.

In the United States *Nautical Gazette* is given a list of seventy-three vessels now being built or about to be built for the United States Navy. The list includes thirteen battleships, six armoured cruisers, nine protected cruisers, four harbour defence monitors, sixteen torpedo boat destroyers, seventeen torpedo boats, seven submarine boats, and a gunboat for service on the Great Lakes. The number of submarine boats will probably be a surprise to many readers, but while the French have talked persistently about their experiments in this direction, the Americans have been quietly and steadily experimenting. The following is the complete list of vessels now already under construction or awaiting contract:—

First-class Sea-going Coast Line Battleships.

Name.	Length.	Displacement.	Speed	Builders.
	Feet.	Tons.	Knots	
Virginia	435	14,600	19	Tenders being received
Rhode Island	435	14,600	19	" " "
Georgia	435	14,600	19	" " "
New Jersey	435	14,600	19	" " "
Pennsylvania	435	14,600	19	" " "
Maine	388	12,300	18	Wm. Cramp and Sons
Missouri	388	12,300	18	Newport News Shipbuilding Company
Ohio	388	12,300	18	Union Ironworks
Alabama	368	11,565	16	Wm. Cramp and Sons
Illinois	368	11,565	16	Newport News Shipbuilding Company
Wisconsin	368	11,565	16	Union Ironworks
Kearsarge	368	11,565	16	Newport News Shipbuilding Company
Kentucky	368	11,565	16	" " "

First-class Armoured Cruisers.

Maryland	502	13,800	22	Tenders being received
Colorado	502	13,800	22	" " "
South Dakota	502	13,800	22	" " "
California	502	13,800	22	" " "
Nebraska	502	13,800	21	" " "
West Virginia	502	13,800	22	" " "

Unarmoured Steel Vessels—Protected Cruisers.

St. Louis	424	9542	22	Tenders being received
Milwaukee	424	9542	22	" " "
Charleston	424	9542	22	" " "
Chattanooga	292	3200	16½	Lewis Nixon
Cleveland	292	3200	16½	Bath Ironworks
Denver	292	3200	16½	Neafie and Levy Shipbuilding Company
Des Moines	292	3200	16½	Fore River Engine Company
Galveston	291	3200	16½	Wm. R. Trigg Company
Tacoma	292	3200	16½	Union Ironworks

Single-turret Harbour Defence Monitors.

Arkansas	252	3235	11½	Newport News Shipbuilding Company
No. 8 (unnamed)	252	3235	11½	Bath Ironworks
Florida	252	3235	11½	Lewis Nixon
Wyoming	252	3235	11½	Union Ironworks

Torpedo Boat Destroyers.

Bainbridge	245	420	29	Neafie and Levy Shipbuilding Company
Barry	245	420	29	" " "
Chauncey	245	420	29	" " "
Dale	245	420	28	Wm. R. Trigg Company
Decatur	245	420	28	" " "
Hopkins	244	408	29	Harlan & Hollingsworth Company
Hull	244	408	29	" " "
Lawrence	248	400	30	Fore River Engine Company
Macdonough	242	400	30	" " "
Paul Jones	245	420	29	Union Ironworks
Perry	245	420	29	" "
Preble	245	420	29	" "
Stewart	245	420	29	Gas Engine and Power Company and C. L. Seabury
Truxton	248	433	30	Maryland Steel Company
Whipple	248	433	30	" " "
Worden	248	433	30	" " "

Torpedo Boats.

Bagley	157	167	28	Bath Ironworks
Bailey	205	235	30	Gas Engine and Power Company and C. L. Seabury
Barney	157	167	28	Bath Ironworks
Biddle	157	167	28	" "
Blakely	175	165	26	Lawley and Sons
Dahlgren	146	146	30½	Bath Ironworks
De Long	175	165	26	Lawley and Sons
Goldsborough	194	247½	30	Wolff and Zwicker
Nicholson	174	174	26	Lewis Nixon
O'Brien	174	174	26	" "
Shubrick	175	165	26	Wm. R. Trigg Company
Stockton	175	165	26	" " "
Stringham	225	340	30	Harlan & Hollingsworth Company
T. A. M. Craven	147	146	30½	Bath Ironworks
Thornton	175	165	26	Wm. R. Trigg Company
Tingey	175	165	26	Columbian Ironworks
Wilkes	175	165	26½	Gas Engine and Power Company and C. L. Seabury

Submarine Torpedo Boats.

Plunger	85	168	8	Wm. R. Trigg Company
Adder	63	120	10	Lewis Nixon
Grampus	63	120	10	Union Ironworks
Moccasin	63	120	10	Lewis Nixon
Pike	63	120	10	Union Ironworks
Porpoise	63	120	10	Lewis Nixon
Shark	63	120	10	" "

Gunboat for the Great Lakes.

No. 16, plans incomplete. Tenders not yet invited.

THE ILLUMINATING POWER OF INCANDESCENT COAL GAS.

Some interesting experiments on the effect produced upon the duty of incandescent coal gas by alterations in the natural illuminating power of the gas itself have recently been published by Dr. Samtleben, of Bremen. The gas was burnt in an argand and with a Welsbach mantle, and it was examined photometrically before and after the addition of varying proportions of benzene vapour, ethylene, acetylene, and gasoline. The argand consumed 150 litres per hour at a pressure of 10 mm. (5·3 cubic feet at 0·39in.); the incandescent burner consumed 100 litres at 30 mm. (3·5 cubic feet at 1·18in.); and the illuminating power is quoted in the annexed tables in German standard candles. The figures are important, not only because they show the relative merits of different substances which may be suggested for the purpose of enriching coal gas, but also because incidentally they once again disprove the assertion that as the incandescent system of illumination is practically ubiquitous, the consumer would not be deprived of any light were the enrichment of gas abandoned and a 13 or 14 candle-power product distributed.

I.—*Benzene Vapour.*

Per cent. by volume.	Candle-power in argand.	Candle-power with mantle.
Traces	8·3	80
1·18	18·0	82·5
1·36	20·2	85
1·78	21·6	89
1·95	22·7	91
2·38	24·6	97

II.—*Ethylene.*

Heavy hydrocarbons + C_2H_4 per cent.	Candle-power in argand.	Candle-power with mantle.
3·8	18·0	86
5·4	18·5	89·5
7·6	19·0	93
10·0	19·5	95
12·6	20·2	96

III.—*Acetylene.*

Heavy hydrocarbons + C_2H_2 per cent.	Candle-power in argand.	Candle-power with mantle.
4·0	18	87
4·4	19	89
5·8	22	92
7·7	24·5	95
8·8	20	102

IV.—*Gasoline.*

Grammes per 1·5 hectolitre.	Candle-power in argand.	Candle-power with mantle.
—	18	87
7	21	91
10·5	22	94
15	23	96
20	24	98

CAPACITY OF RAILWAY WAGONS AS AFFECTING COST OF TRANSPORT.*

By Mr. J. D. Twinberrow.

Railway working, 1889-1899.—The course of railway finance during the past decade was indicated by diagrams, which exhibited graphically some of the particulars summarised in the annual report to the Board of Trade. The mileage exhibits an increase of 8·8 per cent. upon the total for the last year of the preceding decade; capital has increased by 31·4 per cent., a portion of the advance being due to nominal additions resulting from the division of ordinary stock; 14·5 per cent. has been added to the amount available for dividend; upwards of 3½ millions of this total are derived from sources other than the net receipts of railway working. The rate of increase of capital is thus more than twice as rapid as the growth of the amount available for meeting interest charges.

The increases in the period referred to are 34 per cent. from passengers, 27·5 per cent. from merchandise, and 28 per cent. from minerals. The number of passenger journeys yielding the above receipts and the number of train miles necessitated by the traffic were given. Excluding season ticket holders, the journeys have increased by 42·8 per cent., but in the absence of information as to the number of passenger miles the actual increase of the service rendered cannot be stated; the passenger train mileage is 34·5 per cent. greater, so that the earnings per train mile have diminished slightly during the period under review.

The tonnage of merchandise and minerals handled is 36·9 per cent. greater in the case of merchandise and 40 per cent. in minerals; the train miles are 27·8 per cent. more, practically the same proportion as the advance in receipts. As the rates per ton-mile do not appear to have experienced a considerable reduction, the paying load per train mile has remained stationary, but the average length of haul has decreased. The earning capacity of the trains is slightly less, whilst the cost of working same is increasing; any improvements which may have been effected in the construction of locomotives and rolling stock, and in engineering practice, have not been of sufficient moment to counteract the increasing cost of labour and materials.

The principal factor in reducing the cost of a product is the economy of labour in its manipulation, and this is effected in modern industries by improvements in plant or tools, whereby both the output and the remuneration of labour are increased; the results of railway working in the British Isles afford no evidence of the adoption of that principle to this important branch of industry. The useful product of railway working is the passenger or ton-mile; since these units determine the earnings, they should also form the basis for calculating the costs; but it is customary to refer the expenses of British railways to the arbitrary and unmechanical unit of the train mile. This naturally tends to direct effort to the reduction of costs per train mile rather than towards developments of which the immediate effect may be an increased cost per train mile, though the final ratio of earnings to costs is improved. The ratio may be improved in two ways—first, by refining to the utmost possible extent the stock and plant employed to work trains of constant earning capacity; or secondly, by the efficient utilisation of machinery and vehicles of greater earning capacity, permitting the realisation of larger receipts per train mile.

The economies possible under the first heading are very limited, because refinement of design can only be expected to reduce the cost of fuel and repairs by a small amount, and will hardly affect the labour employed in working trains. If it were practicable to design a locomotive of such excellence as to save all the fuel, and at the same time avoid any increase in the cost of repairs, the result in working standard mineral trains would be a saving of 3d. per mile, or, say, 25 per cent. of the cost of locomotive power per train and per ton-mile. If, on the other hand, the average gross train load were doubled, by the efficient employment of engines of 100 per cent. greater hauling power, the cost of fuel per train mile would be increased to 5⅜d., and 50 per cent. might be added to the cost of repairs per mile run; yet the final result, without in any way trespassing on the limits of practicability, would be a saving of upwards of 30 per cent. in the cost per ton-mile. But apart from any change in the motive power, the gross earnings per train mile may be increased by employing vehicles of greater earning capacity, the saving in tare weight being replaced by an equivalent amount of paying freight.

The movement of goods upon the railways of the United Kingdom exceeds 415 million tons yearly; general merchandise accounts for 28 per cent. of this total, the remaining 72 per cent. being comprised of minerals. The mileage worked by goods trains is upwards of 177 millions, and in 1899 the gross earnings realised amounted to £52,116,994, of which about 42 per cent., or £21,834,477, was yielded by mineral traffic.

Thus minerals constitute nearly three-fourths of the bulk, but yield little more than three-eighths of the revenue, the reason for this being that the schedule rates for minerals are lower than those charged for general merchandise, whilst the average haul is probably shorter; yet the fact that the wagons are loaded to their full capacity, and can usually be dealt with in full train loads, whilst there is no expense involved in collection and delivery at terminals, renders this traffic fully as remunerative as that which is carried at higher schedule rates.

It is obvious that any saving which may be effected in the tare weight of vehicles employed in this class of traffic will permit of an equivalent addition to the paying load without increasing the cost of working; *i.e.*, a greater volume of freight will be moved by working the same train mileage, or the same traffic may be handled with a proportionate reduction in the train mileage.

The average tare weight of a British mineral train is about 39 per cent. of the gross load, so that 61 tons out of every 100 tons of full trains are paying freight; if one-third of this dead weight is saved by the introduction of wagons of increased capacity, the tare is reduced to 26 per cent. of the gross, so that the net load is increased to 74 tons out of every 100 tons; this is equivalent to an advance of upwards of 21 per cent. in the gross receipts, or if the receipts remain constant the train mileage necessary may be reduced by 17·5 per cent.

A train of standard 10-ton wagons will hold a paying load of 0·52 ton per running foot, about one-sixth of the total length being accounted for by the vacant spaces between adjacent headstocks; by increasing the capacity of the wagons, a paying load of 0·84 ton per foot can be readily obtained, and thus the capacity per unit of length of train or siding is increased by 62 per cent.

The assumption is sometimes adopted that the short haul characteristic of much of the goods traffic in this country will prevent the realisation of the economy which has followed the introduction of rolling stock of high capacity on American railways; but this conclusion is hardly warranted by a consideration of the influence of the decreased mileage per ton upon the working expenses. The effect of the shorter haul is to enhance the relative importance of terminal charges and to increase the ordinary working expenses per train mile, because the daily mileage obtainable from engines and wagons is thereby decreased. It therefore tends to emphasise the necessity for increasing the gross receipts per train mile; whilst the multiplicity of junctions and sidings gives additional importance to the compact formation of trains of high capacity rolling stock.

In dealing with general merchandise the British trader expects to have each individual consignment loaded into a separate vehicle and forwarded direct, without delaying the wagon to fill up with other goods for the same destination; many British railways have analysed the traffic leaving important goods yards, and find that the average load per wagon is less than two tons, from which they conclude that a small wagon will yield a better actual ratio of load to tare than larger vehicles of greater nominal capacity, whilst the proximity of important towns on most of the great railway systems tends to diminish the advantage and to increase the delay incidental to the practice of transhipping from partially loaded wagons at intermediate junctions. The total cost of working goods trains approximates to 1d. per truck per mile, but the practice of cutting off a wagon or two at a certain junction will not save this amount, as there is very little difference between the cost of working a partially-loaded train and one which is loaded right up to the capacity of the engine; but transhipment might be practised with advantage in connection with long-distance traffic, when it promises to release daily a sufficient number of vehicles to enable a reduction to be made in the train miles necessitated by that traffic.

On the whole, the carriage of general merchandise does not offer so favourable a field for the introduction of high capacity stock as does the mineral traffic of this country, but certain classes of merchandise, such as timber, bricks, rails, rolled steel work, &c., which in any case involve the provision of special rolling stock and which are generally dealt with in large consignments, might with advantage be loaded in large wagons of low-tare weight. The Great Western Railway has built some bogie wagons for rail traffic, each capable of loading 40 tons, the tare weight being 17 tons 7 cwt. These wagons have a trussed steel underframe 45ft. long, provided with fixed bolsters for the reception of the load; the sole bars are supported by suspension bolts bearing in spherical washers, secured at their lower ends to cross bars passing beneath the bogies, to the side frames of which the upper ends of the bolts are attached. This style of bogie dispenses with the heavy transoms and bolsters needed to transfer the load to the customary bogie pivot and thence to the side frames of the truck.

It is possible to construct a wagon having a body of twice the standard capacity with an increase of one-third only to the tare weight; the resulting gross load per axle will then be 14 tons, but since the enlarged capacity must be obtained chiefly by increasing the length, the wheel base of the four-wheeled vehicle will be so great as to occasion some inconvenience on the sharp curves of sidings in colliery yards and factories, and will involve greater resistance to traction on ordinary curves. It will also necessitate the removal of short turntables and traversers.

Both the Great Western Railway and the London and North-Western Railway are experimenting with steel coal wagons of 20 tons capacity; the wheel base is 12ft. in each case, and the bodies are provided with side doors for unloading. The tare weight of the Great Western wagon is 8 tons 6 cwt., whilst that of the London and North-Western has been reduced to 7 tons 18 cwt. by the expedient of employing thinner plates and a lighter underframe.

The author proposes to overcome the objections due to length of wheel base by mounting the axles in a cantilever extension truck, which supports the underframe by means of a pair of laminated springs carried upon each end of the frame, which extends beyond the axles, and by intermediate helical springs. The design was described at some length.

The successful introduction of high capacity wagons, either of the four-wheeled type, as tried on the Great Western and London and North-Western Railways, or of the eight-wheeled bogie pattern, is entirely dependent upon a satisfactory solution of the question of terminals. The substantial economies promised will doubtless justify a very considerable expenditure of capital in the alteration of existing plant; but the carrying out of such a change without interfering with the normal course of trade will demand careful consideration, and as many of the terminals where the loading and unloading are carried on are private property, it is not probable that the owners will incur the cost of alteration to suit an innovation, from which the railways will be the immediate gainers. In connection with the coal traffic, the terminals will be found to fall under the following classification:—(*a*) Producer's terminal—colliery yard. (*b*) Consumer's terminal—industrial establishments, &c. (*c*) Trader's depôt—distribution by cartage. (*d*) Shipping terminal of railway or dock company.

Terminals of class (*a*) will usually admit long wagons without alteration, but the levels of the screens and filling spouts limit the height above rail level; the weighbridges are usually adaptable for bogie wagons, if the load on each bogie is taken separately.

In the older establishments of class (*b*) short turntables and sharp curves with light rails are of frequent occurrence, the arrangements for shunting are often of a primitive nature, and would be unequal to the task of moving wagons of greatly-increased gross weight. In the North-Eastern districts of England the coal wagons are invariably of the self-discharging hopper type, and industrial establishments are usually fitted to take advantage of this inexpensive method of unloading. An instance of the influence of terminal arrangements on cost of handling may be quoted. A firm having a large daily consignment of coal contracted for the labour of unloading the mineral at the various points of consumption at the rate of ¾d. per ton, and found that the unloading of wagons provided with side doors, which were sent with a special consignment from another district necessitated an increase of the cost to 1s. 2d. per ton. Self-discharging hopper wagons are also used to great advantage in some of the large gasworks in Midland towns. Many large works situated in densely populated districts have not sufficient yard area to allow of the elimination of turntables; the working of their traffic in large wagons can then only be effected by the construction of a depôt into which the railway wagons would discharge with the least possible delay, and from which the coal would be distributed to various points within the works by means of conveyors or by small wagons running upon the existing lines. The proprietors cannot be expected to make the necessary

* The Institution of Mechanical Engineers. Abstract.

alterations in order that the carriers may reduce the cost of transportation; the suggestion may be made that the provisions of such depôts on consumers' premises at the cost of the railway company is worthy of consideration, when the volume of traffic is such that the annual saving in transporting same will liquidate the capital charges on the cost of the new plant. The interest of private owners in the introduction of high-capacity wagons is at present limited to the advantage of lessened first cost and repairs per ton carried, it might be possible to afford them an opportunity to share in the reduced cost of transportation by altering the basis of the charges from the net to the gross tonnage, reducing the rate in the inverse proportion of those weights. Thus, if the existing net load be 61 per cent. of the gross weight, the rates when charged on the latter would be reduced by 39 per cent. in order that the revenue yielded by the traffic might be unaltered; but the change will afford the trader a direct incentive to reduce the proportion of tare weight by adopting high-capacity wagons.

Traders' depôts of class (*c*) consist frequently of a length of siding with space for bringing carts alongside the wagons, from which the load is discharged through side doors; when the tonnage dealt with daily is insignificant, the carts are loaded directly from the railway wagon as required, and the wagon serves as the trader's store; a small wagon is therefore preferred, as it lessens the liability to a charge for demurrage. Three wagons of 10 tons capacity must be kept in constant service in order to supply the requirements of a retail trader using, say, 5 tons daily; but, if a depôt were constructed with a capacity of, say, 40 tons, the trader's requirements would be met by the use of a single large wagon arriving at eight-day intervals, and if the depôt be situated one day's journey distant from the colliery, and allowing one day for emptying and refilling, the use of the wagon will be required for three days in each period of eight days, therefore the average daily employment of tonnage will be $\frac{40 \times 3}{8} = 15$ tons, or 50 per cent. less than the capacity employed daily in maintaining an equal volume of retail trade on the old system. Many of the coal terminals in London consist of parallel lines of way spanning the upper portion of hopper-shaped stores from which the road vehicles are filled at a lower level. The lines are usually connected by short traversers, or by turntables, and would require to be remodelled to accommodate wagons of high capacity; but, owing to the great volume of the traffic and the considerable distance over which it is transported, a small economy per net ton-mile will justify the expenditure of a considerable sum in order to effect the necessary alterations.

The terminals of class *d* present a variety of features, differing in accordance with the practice of the various districts from which coal is shipped.

Shipping plant was illustrated and discussed by the author. Scotch plant consists of a pivoted hydraulic jib crane, fitted with blocks and ropes or chains for lifting and for tilting, and of a simple cradle of sufficient length to accommodate the wheel base of an ordinary wagon. The cradle rests upon a seating with its rails in line with those of a length of siding, from which the loaded wagon is pushed into place, being retained by the curved ends of the rails of the cradle against which the leading tires rest; the cradle is then lifted, and swung over the hatchway, and the tilting gear is raised in order to discharge the load through the end doors. The cranes being of an ordinary type are adaptable to the loading and discharge of all classes of heavy and bulky cargo, the only special feature being the cradle, which is, however, of quite simple and inexpensive construction. The practice of swinging the wagon out beyond the quay enables the coal to be discharged from a less elevation than that necessary in cases where the passage of the mineral from the quay line to the hatchway is effected by gravitation down inclined spouts.

End-tipping wagons are exclusively used in the Welsh coal trade, but the method of tipping is not the same. The wagons are usually run upon roads parallel to the quay, turned at right angles thereto, and run on to the platform of a hoist, which is then raised to the requisite elevation, and tilted to discharge the load into an adjustable spout projecting over the hatchway of the vessel alongside, the empty wagon is then lowered, turned, and run on to the empty roads.

Durham and Northumbrian coals are transported in self-discharging hopper wagons, the shipment being effected from timber staiths which contain hoppers fitted with spouts projecting laterally over the vessels lying alongside. Tyne Dock, near South Shields, in Durham County, holds the record for the monthly and yearly tonnage placed on board. The wagons are run by gravitation down central roads, and in passing the short length of sharp inclination acquire sufficient impetus to travel through trailing points on a rising grade, by which they are brought to rest and their motion reversed; they then take the points leading to the hoppers, where they discharge their loads and run back on the "empties" road. The ease and rapidity of the process, the small number of men employed, and the absence of costly machinery, are features which stamp this plant with the character of an engineering achievement of the highest order.

The author desires to express his thanks to Mr. J. F. McIntosh, member of this Institution, for particulars of Scotch shipping crane, and for suggestion and encouragement in the preparation of this paper; also to P. W. and C. S. Meik for photographs and particulars of a hydraulic coal tip; and to Mr. C. A. Harrison for drawings, &c., of the staiths at Tyne Dock.

INSTITUTION OF ELECTRICAL ENGINEERS.

INAUGURAL ADDRESS,

By Professor JOHN PERRY, M.E., D.Sc., F.R.S., President.

(*Continued from page* 494)

OUR chiefs, the men who run us all, our real men at this Institution, may be called practical idealists. They have imagination and judgment and individuality. They have the imagination and enthusiasm of inventors, and yet they are more than inventors, for they can estimate the worth of their own inventions and control their imaginations. They are ready to receive all new ideas, they welcome all new things, and yet they are not carried away. They are radicals and yet they are conservatives. They have what Mrs. Beecher Stowe called faculty.

A strong imagination well under control, surely it is the greatest of mental gifts. I look round me and wonder how many of us really have it; and how many of us are only dull music-hall loving men, who scorn novels and poetry, who live utilitarian, material lives, whose aim is merely to make money through electricity, who love it not for its own self, who cherish their "tuppeny-ha'penny-worth" of theory because it is sufficient for their immediate wants. Why, even the writers of leading articles in the daily papers can talk of the wonders of electricity and what may yet come to pass; and yet we who make machines and use them and switch the marvellous thing on and off and take all sorts of liberties with it—we are like Calibans oblivious of the wonders of the fairy isle—like soulless priests making a living in the temple of Isis—like Aladdins who rub our lamp only to get the necessaries of life.

Twenty years ago some of us were laughed at for our optimism, and yet everything that we declared then to be doable has now actually been done by engineers, except the thing which was then and is now declared to be the supremely important thing, namely, the electric consumption of coal. We say now, as we said then, "The applied science of the future lies invisible and small in the operations of the men who work at pure chemistry and physics." And think of the wonderfully rapid rate at which laboratory discoveries have been made in the last eleven years, and how as the years go on they become more and more numerous; and yet many of us plod along with our work seeing no farther than our noses. A year is now more pregnant with discovery than a hundred years used to be, and yet the protective stolidity of our ancestors is upon us, and we think of the latest discovery as if it were really the very last that can be made. A thousand men are measuring and trying new things in laboratories all over the world. Some of them plodding and soulless; others of them with imagination and clearness of vision. Do you think that nothing is to come from all that work?

And is it not one of the most important functions of the engineer to do as Mr. Marconi has done, to convince capitalists ignorant of science that if the successful laboratory experiment is tried on the large scale it must also be successful? And are we going to leave all this pioneering work, with all its possibilities of great gain, albeit with possible loss, to foreign engineers, when in most cases the scientific discovery has been made in England? Are we so lacking in the hope and faith which are born of imagination and science? And must we in the future as in the past have to rely upon the influx of the clever foreigner like Sir William Siemens? Must we, Boer like, always depend upon our Uitlander population, Fleming and German, Hollander, Huguenot, and Hebrew, for the development of our natural resources?

Some of the best engineers I know are so exceptional that one must class them with geniuses; they have faculty and character, and so they have become engineers even under the most unfavourable circumstances. They have passed through ordinary schools and yet developed common sense. They were pitchforked into practical work, and their liking for the work as well as some curious kind of instinct led them to pick up all sorts of knowledge which have become part of their mental machinery. They continue to pick up new kinds of knowledge when these become necessary for their professional work. Unfortunately these men do not realise how exceptional they are, and they advise boys to go direct from school into works. They forget that the other 99 per cent. of men treated in the same way as themselves can only become the hewers of wood and drawers of water to real engineers. Treated in this way average boys are just like so many sheep: they learn just what seems absolutely necessary and no more; their acquaintance with the scientific principles underlying their trade is a hand-to-mouth knowledge which becomes useless when their trade undergoes development.

In 1867 I was an apprentice, and when in the drawing-office and pattern shop I remember well how I was chaffed for studying such a non-paying, non-practical subject as electricity. When I published my first electrical paper in 1874 before the Royal Society, and even for some years afterwards, the real students of electricity in England could be counted on the fingers of one's hands. Many of us remember the first Gramme magneto machine that came to this country, a scientific toy, in 1874. How many engineers dreamt that a great new branch of engineering had been started? Even in 1878 engineers were as a rule quite ignorant of electricity, and since then every year, although newspaper writers have talked largely of the age of electricity, the men actually engaged in electrical industries have acted as if the greatest of changes were not perpetually going on in it. To be left behind, or to become camp followers, children of Gibeon, this is the usual fate of the men who scorn theory. In 1892-4 we used to have to pay men £200 and £300 a year because they had a slight knowledge of electrical matters. In 1884-6 these very men were not worth 20s. a week; they were weeded out of the profession and their places were taken by men of better knowledge. Two or three years after, these better men were again found to have been weeded out, because men of still better knowledge were available. And so it has gone on ever since. Men learn just enough to get posts; they settle down in these posts and scorn theory. They actually forget what little theory they once did possess. They know a great deal about existing machines, but presently they discover that improvements have been going on, and that they no longer have a right to say that they belong to the engineering profession. In every year one has told men, "You will be left behind. See A and B and C. I told them three years ago, when their names were in everybody's mouths, that they would be left behind like their predecessors, and they laughed. Now I tell you and you laugh, and you also will be left behind. Yes, I know that you get a good salary or large fees, and your head touches the sky. Nevertheless, because you neglect theory and the simple mathematics by means of which theory is made available in practical problems, you will have to take a back seat presently, for our profession is in its early youth and is growing rapidly."

Remember that I do not now refer to the few exceptional heaven-born engineers who, in spite of bad training, do manage somehow to pick up the necessary knowledge. I speak of the average men, many of whom are now living in the same old fool's paradise. They know enough for present needs; they scorn the simple principles which underlie all our work; they scorn the easy mathematics by which these principles are most readily employed in practical problems. They will have their reward.

Much of the evil we suffer from is due to our average young men being pitchforked into works where they get no instruction as soon as they leave school. If ordinary school education were worth the name, and if schoolmasters could be brought to see that we do not live in the fifteenth century, if boys were really taught to think for themselves through common-sense training in natural science, things would not be so bad. But the average boy leaves an English school with no power to think for himself, and with less than no knowledge of natural science, and he learns what is called mathematics in such a fashion that he hates the sight of a mathematical expression all his life after.

And what is the result? English engineers do make a wonderfully intimate acquaintance with the machines and tools that they work with, but when it comes to the manufacture of new things they do it by fitting and trying, by quite unnecessary expenditure of money through trial and error. A machine is made and tried, and then another better one, until a good result is arrived at. And this method did well enough in the past, and would do well enough in the future if only we had not to compete with foreigners who can really calculate. It is not all smoke; there is a real danger in this foreign competition unless we mend our ways. There is an absolute necessity for great change in English ways; but there are so many people interested in the maintenance of old methods of working; so many people who think they will lose their bread and butter if a change takes place; so much capital, scholastic and other, invested in our old machinery, that it takes a catastrophe to produce changes. Much of the strength and weakness of England has always lain in her conservatism. We have been talking of standardisation of machinery lately, so I may say that things have been standardised in England for a long time. Now to get all the good effect of standardisation it is occasionally necessary to go in for wholesale scrapping, and it is this scrapping part of the business that we dislike in England. We here all know that the District and Metropolitan railways might have been worked electrically years ago just as easily as they will be when we are allowed to begin upon them, but of course the scrapping of a lot of steam locomotives was a serious thing. The loss of experience to English electrical engineers, because of this hatred of scrapping, is leading to other incalculable losses. I understand that the whole generating and line plant—the whole machinery of the Boston tramways—has been scrapped several times since they first were driven electrically. Japan has scrapped all her old civilisation just as France did. During the century now dying Germany has made the most sweeping changes in her law and school legislation, and indeed in everything. England, and Spain, and China, how they differ in this respect even from England's own colonies.

Of course it may be said that English customs have grown during centuries; they are well tried, and there is no pressing need for sudden alteration. I quite agree, but unfortunately this very perfection and fitness of our customs have bred in us a want of flexibility, so that in cases where a sudden change is really necessary, we are disinclined to make the change merely because it is a change and for no other reason.

No one has ever heard me speak of the decadence of England. When the greatness and the wealth, the manliness and the strength, the healthiness and good life of England are shown forth to the as yet ignorant world in all their magnitude there will be some astonishment. But it is our duty to keep up our high standards. We must change what is bad when we know it to be bad, and not let bad things* continue to exist, parasitic growths, maintained because on the whole we are strong and healthy. You will perhaps think that this is a very serious exordium when I tell you that I have introduced it all on account of the state of mathematics in our profession. I feel a sort of degradation every time that I hear a successful, clever old member of this Institution sneering at mathematics. There is a plausibility about his statements; he himself has been very successful in life without much help from mathematics; but indeed his sneer is doing a great deal of harm to the younger members who admire his success, who forget that he has succeeded in spite of, and not because of, his neglect of mathematics.

(*To be continued.*)

PLATINUM IN NORTH AMERICA.†

IN the summer of 1898 a demand suddenly arose for commercial quantities of the element osmium. At least half a ton was wanted for the manufacture of a new incandescent light by the Welsbach Light Company. This led the writer to examine localities where platinum had been reported, in order to determine whether osmiridium was contained in the crude platinum.

The notices of the occurrence of platinum in this country given in scientific journals include two interesting observations in the East. One concerns a nugget said to have been found on land adjacent to the village of Plattsburgh, which weighed 104·4 grammes, and contained sufficient chromite to reduce the specific gravity from 17·35 for the heaviest portion to 10·446 for the average of the nugget. This nugget gave "unmistakeable evidence of osmium."

Messrs. William E. Hidden and J. H. Pratt have found sperrylite—platinum arsenide—in placers at several points in the Cowee Valley of North Carolina. The conditions favour the belief that the source of this mineral is a ledge of impure rhodonite and biotite, containing much disseminated iron sulphides—conditions much like those at Sudbury, Canada.

There have been unsubstantiated reports of the occurrence of platinum in place, in certain localities in the Catskills in New York, in granite near Philadelphia, and again near Port Deposit, Maryland; but the only localities where platinum is known to occur in North America, otherwise than as a mineral curiosity, are in California, Oregon, and British Columbia.

As early as 1852 Prof. W. P. Blake called attention to the existence of platinum at Port Orford on the Oregon Coast, and noted that the platinum equalled from 10 to 30 per cent. of the gold. This article seems to be the original source of the statement that the proportion of platinum to gold increases northward. B. Silliman in his mineralogic notes on California, &c., extended our knowledge to the occurrence of platinum in the older deep placers, worked by the hydraulic process in Butte county. He also notes the occurrence of iridosmine with the platinum. Meanwhile T. Sterry Hunt had found platinum and iridosmine on the Riviere du Loup, Quebec, Canada, in 1851.

The publications of the California State Mineralogist show that platinum has been found at many places on the Pacific beach, from as far south as San Bernardino county, northward to the mouth of the Columbia. Indefinite reports have been made of its occurrence further north on the Washington beach; but its amount is certainly not great. Many of the beach mines have yielded platinum in commercially appreciable quantities. Still further north, platinum is found at Yaquina Beach, Oregon; but the sands there are poor. Port Orford has proved, perhaps, the richest beach.

All this beach-platinum is discouragingly fine and difficult to save. Most of the platinum product has come from inland diggings, where the grains are comparatively coarse. It has become well known in certain of the placers of California.

Though platinum metals are so frequently found in many of the gold placers, their occurrence in this region is by no means universal. The platinum-bearing placers confirm the accepted idea that the platinum originates in the serpentine rock in which this region abounds; for the platinum-bearing gravels are sure to be closely associated with some prominent serpentine ridge.

A hurried trip through this region enabled the writer to learn, by the analytical aid of Dr. Waldron Shapleigh, that in the Bee Gum district of Shasta county, at Hay Fork, and at Chapman's mine on the Trinity, osmiridium makes up perhaps the greater part of the mixture of platinum metals. At Chapman's mine, Colonel Barrows obtained 30 oz. of small nuggets, averaging ⅛in. in diameter, apparently altogether too hard for platinum, and yet considerably coarser than is usual for osmiridium, which has the habit of occurring in very small scales. Dr. Shapleigh has shown that these nuggets yield a small amount of platinum on treatment with aqua regia, and then fall apart into the ordinary scales of osmiridium. He has found, also, that the Pacific-beach platinum often contains more than 90 per cent. of osmiridium. This explains the fact that little effort has been made to mine the platinum; for, until recently, the osmiridium has had practically no value.

In examining the well-known platinum localities on Granite Creek, in British Columbia, it was estimated that the placers contained about one-fifth as much platinum as gold. I could get no test for osmium, but Dr. Hoffmann, of the Canadian Geological Survey, has found samples of platinum yielding as high as 25 per cent., and on the average about 10 per cent., of osmiridium.

In further search for the platinum metals, the writer collected heavy sands from placer mines in California, Oregon, Washington, Idaho, Montana, and Alaska. These samples averaged 4 lb. in weight. The sand was first separated by ordinary assay-sieves into about nine sizes: coarser than 20-mesh; through 20, 40, 60, 80, 100, 120, 160, and then 200-mesh. Each size was then in good condition for easy separation of the highly magnetic portion by a rude form of separator. By limiting the magnetic separation to the highly magnetic particles, very little of gold or platinum was removed with the magnetic portions—as the panning of these portions proved.

By panning each size, and then counting—or weighing, where the amount was considerable—the flakes of gold and platinum, a fair idea of the proportion of platinum to gold could be gained. As the sieving was carried to such uniform sizes, it was possible, by counting weighed amounts, to estimate the unit weights of flakes of the different sizes, and thus to approximate roughly the total weight of gold and platinum obtained.

In addition to the sands mentioned above, about 25 oz. of Klondike gold dust was examined, and only a grain or two, probably of platinum, was found.

A NEW Company has been formed to work the Talbot continuous steel-making process under the title of the Talbot Continuous Steel Process, Limited, capital £300,000 in £1 shares. The prospectus will be found in our advertising columns.

* Such as our wretched system of weights and measures. O young America and Australia, is it wise to waste a year of every child's life, and years of the life of every business man, merely because we do it in England? You get many of your pedagogues from us, and of course they say that without cwts., qrs., and lbs., and Latin declensions and Euclid, the mind cannot be trained. Do you believe them, or are you with open eyes making a great sentimental sacrifice?

† A paper by David T. Day, presented before the American Institute of Mining Engineers.

ELECTRICALLY-DRIVEN PRINTING PRESSES.

In our issue of July 13th last we went somewhat fully into the question of the driving of printers' machinery by means of electricity. Of course it was impossible in the scope of that article to include details of every system at work in this country, and it may therefore be that a few further remarks of the "teaser" system, as worked by a number of English, Irish and Scotch newspapers, may prove of service to our readers. By the courtesy of the proprietors of our contemporary the *Daily Express*, we have been permitted to examine the installation of that newspaper, which is one of many erected by Bergtheil and Young, who are the representatives in this country of the Bullock Electric Manufacturing Company, of Cincinnati, U.S.A. Here there are three quadruple presses capable of printing and delivering ordinarily 40,000 eight-page papers per hour, and up to 47,000 copies per hour in case of emergency. These presses are each coupled by a two-to-one reduction gearing to a four-pole fifty horse-power Bullock motor, the ordinary full-load maximum speed of which is 400, so that the ordinary maximum speed of the main shaft of the press is 800. The armature of the motor and the pole pieces are laminated. The coils of the armature are embedded in the iron, and protected at the circumference by hard wood wedges. The motor, which is compound-wound, is placed beneath the floor, and is completely out of away to the negative main. In Fig. 2 the line resistance D, shown dotted in Fig. 1, is brought into play, and the big motor is receiving current both from the main, direct through a resistance, and also through the "teaser." In Fig. 3 the "teaser" and resistance D have both been cut out, and the large motor is shown running direct on the mains. Of course, there are intervening steps; these changes are not brought about in jumps, but gradually. The "teaser" itself is cut out by an automatic switch, which acts as soon as the "teaser" ceases to supply any current. There are the usual push buttons working in conjunction with a small battery in various positions on the press and on the controller by which the current can be cut off from the motor and the press stopped if desired. There is also an automatic switch which opens in the case of over load, such as hot bearings or a jamb in the press. In such cases it is impossible to close the circuit again till the controller has come back to its starting position, for a switch inside the controller falls open, and cannot be closed unless the controller handle is turned back to this position.

Still another method of electrically-driving printing presses is that known as the Ward Leonard system. This differs from any we have yet described, and is said to be largely in use in the United States. In this case the regulation of speed is brought about by arranging a motor generator to aid or oppose the press motor, in the manner shown in Fig. 4.

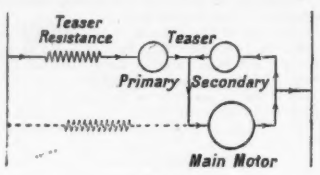


Fig. 1

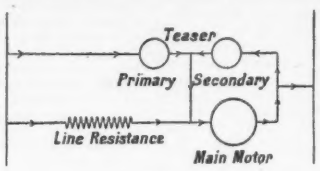


Fig. 2

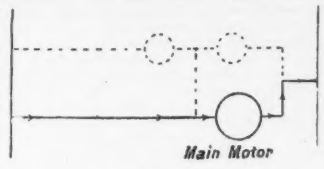


Fig. 3

the way. Close beside this motor is another which is considerably smaller, and the armature of which has two windings, so that the machine acts as a motor generator, the generated current being four times as great in quantity as the current taken by the small motor, but of a proportionally less voltage. By means of a controller of special design, it can be arranged that the larger motor shall first of all have current supplied to its armature by this small motor—its fields being always excited from the main current of higher voltage—and afterwards, the small motor being cut out, shall have the current direct from the mains. The system, in fact, has been developed primarily as a method of providing a means for obtaining the extraordinarily heavy starting torque required by large machines having a large moment of inertia, without an undue demand on the supply mains or other source of power. Large machines, even when speed has been got up, require a very considerable quantity of current; but the current necessary to start the motors attached to these large presses and to gradually raise their speed is much greater. It is by no means unknown for the current at starting to be five or six times what it will be at full speed and full load. It is manifest, therefore, that supposing full load current is 80 ampères, the starting current may be as high as 480 ampères, if nothing were interposed between the motor and the source of supply, and this large current, though only temporary, may have anything but a desirable effect upon the mains. It will be remembered that in the Holmes Clatworthy system there are also two motors, but in this case the small motor instead of supplying current to the large motor is connected through a clutch to the shaft of the large motor by means of worm gear.

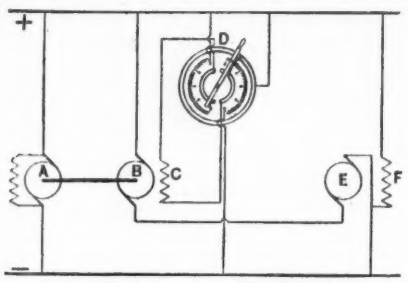


Fig. 4—WARD LEONARD SYSTEM

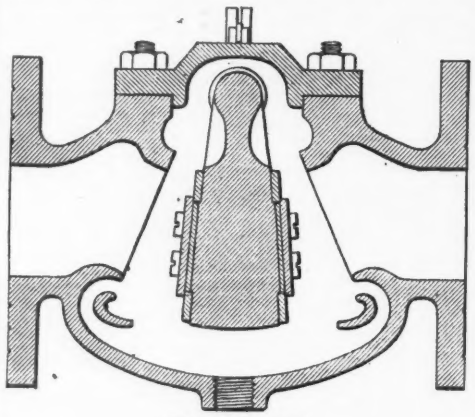
Both systems aim at the prevention of a large rush of current at full voltage from the mains or dynamo driving the motor.

In the article already alluded to we gave some account of the working of the "teaser" system, and it will not be necessary to go into the question again very deeply here, but certain of the appliances used by the Bullock Manufacturing Company are well worthy of attention. The controller, although somewhat large, is not unduly so, and it is an ingenious contrivance. It is impossible, it is said, for a driver to make any mistake with it; current cannot suddenly be switched on, for example, and it is impossible for the motor to be reversed—or rather for current to be supplied to it in such a way that its direction of rotation would be reversed — without the switch being brought back to starting point with all resistance in. We mention this latter question because one of the motor equipments which we saw was provided with a reversing arrangement. With some presses it is not considered a good thing to reverse their direction of rotation on account of the knives; but in this instance it was specified and supplied, and is, so we were informed, extremely useful and a saving of time. The functions of the controller are many. It closes the circuit in the first instance on to the primary and field of the "teaser" motor and on to the field of the large motor; it then gradually increases the speed and output of the "teaser," and hence the current flowing through the large armature; then, when the speed of the large motor is high enough to permit its armature being put across the mains, the controller does this, subsequently cutting the "teaser" out of circuit. The controller then regulates the speed of the big motor, finally weakening its field when the highest speeds of all are desired. The accompanying sketches illustrate the three principal relative conditions of the large motor and teaser. Fig. 1 in the full lines shows the the current coming from the positive supply main through the primary winding of the "teaser." The current from the secondary of the "teaser," together with the current which has come through the primary then goes to the large motor armature, and thence

It will be observed that there is no large resistance in the main circuit. A and B represent a motor generator, B being the generator. C is the field of the generator portion, and is regulated by the reversing rheostat D. E is the press motor, and F its field. The rheostat D is so arranged that it can either assist or oppose the voltage of the mains. All the current for E has to pass through B. At starting the voltage of B is equal to and opposing the main voltage. Gradually, by means of the rheostat, the voltage of B is reduced to zero; then the direction of the field excitation is altered, and B begins to generate current in the same direction as the current from the mains. This goes on until the voltage applied to E is double that of the mains, B being capable of generating current at equal pressure with the mains. The armature of E may always work with its maximum current. It will be observed that though there is no resistance in circuit the motor generator has to run as long as E is in action.

ISOLATING STEAM VALVE.

The accompanying illustration shows a section of an isolating steam valve recently introduced by Richard Klinger and Co., of 66, Fenchurch-street, E.C. It is intended that this valve should be mounted direct on the boiler shell, *i.e.*, between



ISOLATING VALVE

it and the stop valve, and it is claimed that it is a safeguard against dangerous escape of steam. In construction it is simple, being composed of a steam chamber provided with a pendulum valve, which can shut on to valve seats in either direction. Thus, if a burst occurs in a steam pipe, it is intended to close in one direction; whereas, where a bank of boilers are used, if an accident should happen to one boiler the valve is meant to close in the opposite direction and prevent matters being made worse by reason of the steam from the uninjured boilers escaping.

With the object of preventing the valve closing in either direction with too great force, it will be observed that small passages have been cast below the valve seats on either side. These are provided with the intention of affording steam cushions, and so reducing the concussion. Attached to the spindle of the pendulum valve, where it emerges from the valve case, is a pointer, which shows in what direction the valve has been closed. Usually the valves are so arranged that they will close when the velocity of the steam passing through them exceeds the maximum for which they are constructed by 20 per cent., but we are informed that practically any adjustment can be made by adding to or subtracting from the weight of the pendulum. As the ease with which the pendulum swings might be much reduced were the glands of the spindle to be screwed up too tightly, a locking arrangement is provided whereby it is impossible to do this unless a key is procured, which might be kept by some other person than the workman. A cover bolted on above the pendulum valve allows this to be bodily withdrawn if necessary.

Of course, when the valve has closed some arrangement is necessary by which it may be opened again when required. For this purpose it will be noticed that there is a screwed hole in the bottom of the valve case, from which a pipe, provided with a valve, may be taken to the steam pipe, and the pressure on both sides of the valve made equal.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

The question of American competition again occupied a good deal of attention on 'Change in Birmingham this—Thursday—afternoon, but there is reason to believe that the local iron and steel masters are making more headway against it just lately than for some time past. American steel billets and slabs of a certain quality are, however, still quoted £5 5s., delivered into this district, against £6 Staffordshire quotation. In the wire rod trade also continental agents are offering supplies at considerably below Midland rates, and the same may be said of transatlantic material of this kind, for American and Belgian wire rods are being quoted in this district at £7, whereas the usual quotation of late by local makers is £8, although in actual transactions business is concluded at something less. Some purchasers of Staffordshire-made iron bars at £8 and £8 5s. have been trying continental bars, because these last were quoted on a £7 10s. basis, but it is understood that in the cases where the trial was made the results were not satisfactory. The Unmarked Bar Association standard continues £8 10s. to £8 15s., but the iron is procurable from outside firms at less. Sheets, singles, are quoted £8 17s. 6d. to £9 2s. 6d.; doubles, £9 to £9 5s.; and trebles, £9 12s. 6d. to £9 17s. 6d. Galvanised corrugated sheets of 24 gauge are quoted £12 10s. to £13 f.o.b. Liverpool, and some of the local firms are busy supplying South African orders, not only for sheets, but also for small corrugated iron buildings or "huts" for military purposes. One or two large orders of this kind are in hand in the district, and are affording full employment. Hoop iron is £9 to £9 10s.; nail, rod, and rivet iron, £9 5s. to £9 15s.; and gas strip, £8 10s. to £9. A moderate business is doing in pig iron in small lots.

Staffordshire basic steel low in carbon may be said to have almost entirely superseded iron for structural purposes, with a consequent gain of from 30 to 50 per cent. in tensile strength, together with other important advantages which engineers appreciate. For steel of this description makers asked this afternoon £8 to £8 10s. for plates, and £8 to £8 5s. for angles and girders.

Consumers of pig iron appear to be content to cover their immediate requirements by hand-to-mouth purchases. Northampton and Leicestershire sorts are quoted 60s. to 62s. 6d.; Derbyshire, 61s. to 63s. 6d.; and North Staffordshire, 62s. 6d. to 65s. This cautious buying will probably be continued as long as the present uncertainty exists as to what is to be the further course of prices during the coming winter. Good Shropshire cold-blast pigs are quoted 120s., and for inferior descriptions of this sort, low in silicon, makers and agents are disinclined to make concessions. Staffordshire cinder forge pig is still quoted 60s. to 62s. 6d., though the former is more like the business figure. Part-mines are 62s. 6d. to 65s., whilst the various chiefly-used qualities which come under the elastic term "all-mine" are obtainable at almost any figure between 65s. and 77s. 6d, according to the composition of the ores from which it is made, superior sorts ranging up to 100s.

An outlay of about £30,000 has been decided upon by the Brierley Hill Urban Council in order to deal with the sewage on the septic system on the Brierley Estate, which the Council recently decided to purchase.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The iron and steel trades of this district appear to be drifting on towards the close of the year in a very unsatisfactory fashion. Both makers and manufacturers declare that unless there is to be some substantial reduction in the cost of production they have got to the "rock bottom" as regards prices. Merchants and consumers, on the other hand, are not at all convinced that the lowest point has been reached, and still hold back as much as ever from buying beyond what they are absolutely compelled. A very general impression is that a considerable quantity of work, the giving out of which was stopped by the very high prices, is simply pigeon-holed, and will come forward as soon as conditions are considered favourable. The difficulty, however, is that once the slump in the market has commenced, there is so much uncertainty as to when the downward movement will really stop, that all confidence is for the time being destroyed, and so far there is no indication of any sufficiently stable basis being established that is likely to bring about a revival of business.

Only the slowest possible business continues to be reported on the Manchester Iron Exchange, and the meeting on Tuesday was but moderately attended, with an absence of inquiries of any moment the general report both amongst makers and manufacturers. Here and there some extra orders were reported in pig iron at the very lowest prices, but this could scarcely be said to represent any really appreciable improvement in business taking it all through, and for the most part buyers are still quite as chary as ever about committing themselves beyond immediate requirements, and merchants continue low sellers for forward delivery. Lancashire makers book occasional special parcels at about 75s., less 2½ for No. 3 foundry delivered Manchester. Lincolnshire makers' quotations remain on the basis of 65s. 6d. net, with merchants quoting 1s. to 1s. 6d. less; and Derbyshire about 68s. 6d. to 69s. 6d. net. In forge qualities there is practically little or nothing doing to really test prices, which finished iron makers declare have not yet been reduced sufficiently to meet the relatively much lower price of finished material. Nominally quotations remain at about 64s., less 2½, for Lancashire, 62s. 8d. net for Lincolnshire, and 62s. to 62s. 6d. net for Derbyshire, delivered Warrington. Prices for Middlesbrough and Scotch still tend in a weakening direction. Delivered by rail Manchester, No. 3 foundry Middlesbrough could be bought through merchants at 72s. 4d. to 72s. 10d., with makers asking about 73s. 4d. to 73s. 10d. Eglinton and Glengarnock average about 74s. 6d. to 75s. net., with American pig iron remaining at about 63s. 6d. net Manchester docks.

In finished iron the business coming forward is only of the most limited dimensions, and forge proprietors have difficulty in keeping their works running more than about half time. The list basis for bars remains at £8 10s. for Lancashire, and £8 10s. to £8 15s. for North Staffordshire, delivered Manchester. Outside makers are, however, much lower sellers, and the Scotch makers are cutting the market at considerably under these figures. Some extraordinary prices are talked of, and merchants who have anything like tempting specifications to place anticipate being able to buy at considerably under £8 from English makers, and much less from the Continent. Sheets are also extremely quiet, with £9 10s. about an average figure for delivery in the Manchester district. Hoops are perhaps not in quite so altogether unsatisfactory a position, and prices are being maintained at the official basis of £9 2s. 6d. for random to £9 7s. 6d. for special cut lengths, delivered here, and 2s. 6d. less for shipments.

Generally business in the steel trade is in a disorganised condition, with a continued easing down in prices. Hematite makers are now quoting as low as 87s., less 2½, for No. 3 foundry, delivered Manchester, although some special brands are nominally 2s. to 3s. above this figure. Local steel billets are not now quoted more than £5 15s. net, with no business doing even at this figure. Steel bars range from £8 and £8 5s. upwards; steel plates from £7 10s. for strip qualities, with the association basis for boiler plates still £9, less 2½, but in the open market there are lower sellers, and orders could be placed without difficulty at about £8 15s. delivered here.

The situation generally throughout the engineering trades remains without any really material change from what I have reported recently. Although outside electrical engineering and the locomotive building trades the outlook is not altogether satisfactory as regards the new work coming forward, activity in most branches is still well maintained upon orders in hand which will

keep most of the principal firms fully engaged, at any rate into the ensuing year. The textile machinery trades remain in much the same depressed condition, and very little new export work is being got, but in the Oldham district the erection of a number of new mills will provide temporarily a fair amount of activity for some of the local engineering establishments.

The further returns as to employment issued by the trade unions continue generally of a satisfactory character. The local delegate of the Amalgamated Society of Engineers reports the members fairly well employed, and, with the exception of a few instances, an absence of friction. In Manchester the number of unemployed is about 2 per cent., and it is added that the large engineering and tool-making firms are busy, particularly the latter, who are still running overtime. These firms, it is added, however, appear to be full-handed, as there is not that call for men in this branch that characterised the earlier months of the year. With one or two exceptions the textile machine-making shops are slack, the men either being indefinitely suspended or playing "weeks about." In the returns for the society generally, the unemployed list shows a small increase as compared with last month, but the proportion is still only 2½ per cent. of the total membership. It may be added that the membership of the society during the past month shows an exceptionally large increase, the total being now 87,261, as compared with 86,504 at the beginning of October.

The organising delegate of the society for the No. 2 division, which includes the bulk of Lancashire excepting the Manchester district, reports that at the present time there are many questions to contend with, some of them of far-reaching importance. At Bolton and Oldham there has for some time past been the vexed question of unskilled men being put on machines, and within the last few weeks, he adds, fresh encroachments in this direction have arisen at Blackburn and Newton-le-Willows, where negotiations, which are still pending, have been entered into with the firms involved.

The quarterly financial statement issued by the Amalgamated Society of Engineers shows a larger increase in the money balance than in any previous similar period during the last three years. The reserve balances are given at £376,931, as against £349,217 at the end of June; but of the present balance £121,756 belongs to the superannuation reserve fund.

Mather and Platt, Limited, inform me that they have purchased a portion of the buildings and equipment of the American machinery section at the Paris Exhibition, and I understand that this is to be erected here in connection with the new works the above firm are laying out in the immediate neighbourhood of Manchester.

A steady tone generally is maintained throughout the coal trade, and the view of the present position that is taken by the colliers' representatives in some of the Lancashire mining districts may be of interest. They report that the stocks so far accumulated are infinitesimal as compared with the normal condition of affairs at this time of the year. It is the exception rather than the rule where coal is being wound on Saturdays, the miners having an aversion to working six days per week, whilst the colliery proprietors derive little advantage from running the machinery on so short a day. The miners, it is added, are earning good wages, the recognised minimum being 7s. per day, and in many cases they are getting more than their foremen and other officials. Much dissatisfaction exists at not a few pits in consequence of this, and applications on the part of colliery officials for increased remuneration are in contemplation. Endeavours are also being made in various parts of the country to obtain price lists for different kinds of work, in order that the miners may know exactly what they may expect to receive at week-ends, when engaged on other work than actual coal-getting.

All descriptions of round coal are moving off satisfactorily, and the lower qualities continue in fairly good inland demand for steam and forge purposes, and although supplies generally are ample, prices are maintained at about 12s. 6d. to 13s. at the pit. As to engine classes of fuel, some of the Lancashire representatives are talking in a more confident tone with regard to the outlook, and there would not seem to be that anxiety about maintaining prices which was noticeable a week or so back. It can scarcely, however, be said that the actual position generally shows any improvement. There are still plentiful supplies on the market, and not a few of the Lancashire collieries have surplus output hanging on their hands which they are more anxious to dispose of than they have been recently. So far, however, as the association list prices are concerned, these are being firmly maintained at about 10s. to 10s. 6d. for the best qualities of slack at the pit. Slack from other districts still comes forward at considerably under these figures, and as I have previously stated, is largely supplying one or two important Lancashire markets. Some of the largest users of engine fuel are not satisfied with the present position, and several important contracts usually settled about this time of the year are being held in abeyance, users in the meantime buying only over very short periods.

The shipping demand continues to slacken off, and prices show a further easing down, 15s. 3d. to 15s. 9d. representing about the full average figures for steam coal, delivered Mersey ports.

Prices for foundry cokes are steady at about 28s. to 30s., with the basis for furnace cokes about 15s. at the ovens.

Barrow.—There is very little, if any, change to note in the hematite pig iron trade. A fair demand exists, but makers are not doing much business, nor are they in need of orders, being well booked forward, but they are not being so pressed for deliveries on steel-making account, and this has given them greater freedom as a consequence. Makers are quoting 78s. to 81s. per ton net f.o.b. for mixed Bessemer numbers, and warrant iron is at 76s. 3d. net cash sellers, buyers 76s. There is an easier tone in warrants, which is all the more remarkable in face of the fact that warrant stocks are down again on the week to the extent of 2245 tons, making the reduction since last Christmas 170,077 tons, and leaving in hand only 27,770 tons. This is truly a strong statistical position for makers, and will stand them in good stead whenever a removal in trade leads to an increase in prices. There are 37 furnaces in blast, compared with 47 in the corresponding week of last year.

Iron ore is in brisk request, and the output from the mines is all readily bought up, and in addition to this a large weekly tonnage of Spanish and other foreign ores is imported to West coasts. Native ores of good quality are still quoted at 17s. 6d. per ton net at mines, best ores at 22s. and 23s., and Rubio ores at 19s. net at West Coast ports.

The steel trade is very unsteady. Orders are not well held, and the demand for winter deliveries is not brisk. There is a fair demand for hoops and merchant steel, but a quiet tone in heavy rails, ship plates, &c. Prices are easier, but they do not seem to tempt orders. Yet there are good prospects for the trade next spring if it is found possible to ease prices down somewhat. This can only be done by a relief from all elements of cost, fuel being an especially dear feature at the moment. Indeed, for some time past it has been difficult to make ends meet, to say nothing of making profit, in consequence of the high price of raw materials, labour, &c., running away with the profit, which, in brisk times especially, may reasonably be expected to fall to the lot of the manufacturer.

There is no change to note in shipbuilding or marine engineering, but local yards and works are very busy on the Admiralty orders on hand.

The coal trade is brisk, but the market is a bit easier, and prices are likely to come down, deliveries being fuller and the supply at the moment really greater than the demand. Coke is also slightly easier, but the consumption is smaller, consequent on the damping down of two furnaces at Askam, where a wages dispute exists.

The shipments of iron and steel from West Coast ports have been somewhat quiet during last week. The returns show that of iron 6670 tons were exported, and of steel 6782 tons. This compares with 12,010 tons of iron and 6116 tons of steel in the corresponding week of last year—a decline in iron of 5440 tons and steel an increase of 666 tons. Up to date this year the shipments of iron have reached 575,260 tons and steel 355,871 tons, as compared with 462,265 tons of iron and 431,648 tons of steel—an increase in iron of 112,995 tons, and in steel a decline on the year of 75,777 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE South Yorkshire coal trade continues in a state of uncertainty, buyers holding off in the hope that values may fall, and sellers standing stiffly wherever they can to the old rates. Merchants state that there is no likelihood of house coal being cheaper this side of Christmas. On the other hand, there is no difficulty now in getting supplies, and this shows that the time of pressure has passed. While the demand for house coal continues remarkably quiet for the period of the year, merchants state that they have very slender stocks, and the slightest change to wintry weather would instantly restore firmness to business. The early stocking, as has already been pointed out, is accountable for the present languor in household fuel, while the continued mild weather has also contributed to the diminished demand. Best Silkstones, however, continue to fetch from 15s. to 17s. per ton; Barnsley house, 14s. to 15s. per ton. Those who can place large orders are able to do so at lower rates.

Steam coal is now in considerably lessened request, owing to the falling-off for export. The railway companies continue to take an average tonnage, and steadiness, on the whole, marks the business done inland; still, values are lower, Barnsley hards being now easily obtainable at 15s. to 16s. per ton, while concessions from these quotations have been made in several instances. A heavy weight of gas coal is now being delivered on account of contracts; those who have to buy this class of coal in the open market pay more money. There is again a brighter tone in the market for engine fuel for Lancashire and several of the Yorkshire textile centres. The dropping tendency previously noted has disappeared, and although no advance is reported in quotations, all expectations of further weakening of prices are at an end. It is not expected, however, that manufacturing fuel will again reach the values which caused so much trouble a short time ago, as in various directions small coal is being stocked. Nuts make 9s. 6d. to 10s. 6d. per ton, screened slack from 7s. 6d. per ton, pit slack from 6s. 6d. per ton.

The coke trade continues very weak. Producers and merchants are exercised over the changed position, and several interviews have taken place to devise some measures of meeting the situation. As a result production is being materially reduced, and values keep dropping. Ordinary coke is now quoted at 14s. to 16s. per ton, while washed coke is at 17s. per ton.

There is no slackening in the activity which has prevailed all the year in the large iron and steel establishments at the East End in military material, more particularly in armour plates, armour-piercing and other projectiles, in which work is being carried on at high pressure. There never has been a time when the weight of plates ready for delivery, and in course of manufacture, has been anything like so great, while as regards several descriptions of shot and shell the orders have been simply enormous of late, and still continue heavy enough to keep the entire plant going day and night.

An improvement has also to be noted in the railway material trade. Several local companies, including the Midland and Great Central, have given out considerable orders for locomotives, and a large proportion of the material required for them is, as usual, being made in Sheffield, while further additions to this class of work are under consideration. In the local wagon works an unabated demand is reported, not merely in wagons, but in all the accessories required in their building. The first fruits of what is hoped will be a busy market are now on hand in the form of railway works for the Natal Government. On the whole, prosperity continues to be enjoyed throughout all the great works in the East End, although the steel trade in the higher grades is not quite so active as could be wished.

In the lighter industries reports vary very considerably. Although there is a large amount of work doing both in cutlery and plated goods, there is nothing like general activity, and the home demand is much quieter than was looked for during the summer. The fact is, that the stocks left over last Christmas are still heavy, and in spite of various attractive novelties which have been put before metropolitan and other houses, there is no satisfactory response in the travellers' order books. Fashion is again telling in regard to hafting material; stag hooks for walking sticks and umbrellas are not in favour at present, and this change in "the mode" is great enough to cause a collapse in the horn trade. Thus it is that although at this season of the year there ought to be a large demand for every description of common stag and similar lower-priced hafting material for use in the cutlery crafts, the home business is slower than it has been known for many years, and the foreign trade is equally quiet. At the same time there is an improved business done in pressed handles for matchets, spear-point knives, and goods of the cheaper grades generally. These are sent chiefly to South America and the West Coast of Africa. In other specialities of a similar kind there is also a good business doing; several manufacturers state that the demand is far in excess of their facilities for production.

NORTH OF ENGLAND.

(From our own Correspondent.)

THE downward tendency in the iron and allied industries is more marked this week than ever. Demand is slacker than it has been at any time during the last five or six years, prices have continued to decline in most branches, prospects are declared to be discouraging, and the tone of business is anything but satisfactory. There is no inducement of any kind for consumers to buy for forward delivery; indeed, almost everything favours their policy of holding off, and no one buys who can at present do without the iron. The warrant market reflects this feeling very conspicuously, for even for delivery so short a time ahead as a month there is a backwardation of 1s. per ton, and consumers have not enterprise enough to speculate for deliveries to be made next year. In the finished iron and steel industries, the contrast between the state of trade now and what it was in the early part of the year is very noticeable; then manufacturers could not keep pace with the requirements of consumers. Now sellers have to seek buyers.

Buyers have this week been able to get prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron at 64s. 9d., and there has been some business done at even 64s. 6d., though the leading firms have not come below 65s. A very unsatisfactory feature of the trade is that the lower qualities of Cleveland pig iron are dropping in value even more quickly than No. 3, though they have for some time been relatively cheaper. Taking 64s. 9d. as the price of No. 3, consumers under ordinary circumstances would be able to get No. 4 foundry at 64s. 3d., but they have now to accept for it 62s. 6d.; similarly, grey forge is being sold at 60s. 6d., where 63s. 9d. should be got for it. But the production of the lower qualities is more in excess of the requirements than is that of No. 3, and it is believed that makers hold considerable quantities of forge iron—at any rate, they press it considerably for sale. Consumers under such circumstances have no fear that they will have any difficulty in securing all the iron they require whenever they need it, and therefore they will continue their hand-to-mouth policy as long as the market is unsettled and prices show indications of further fall.

Cleveland warrants, which in the summer were 3s. 6d. per ton above Scotch, are now nearly 4s. below them, and as it is again possible to deliver Cleveland iron to Scotch founders at a price which compares favourably with native iron, heavier shipments from the Tees to Grangemouth might be looked for. They have not improved, however. This is all the more surprising when it is borne in mind that No. 4 foundry, which is the quality chiefly taken, is to-day relatively a good deal cheaper than Cleveland warrants, and No. 3 also—it is 2s. 3d. cheaper instead of 6d. only. An increased business with Scotland at this time of the year generally makes up to some extent for the slackening of the over-sea business, but it is not so this year, and sellers are weak in consequence.

The fall in the prices of East Coast hematite pig iron has apparently been checked, as for more than a week the quotations have been stationary, whereas they had been declining for some time at the rate of 1s. per week. In other respects it cannot be said that the situation is any better, for both local consumption and shipments are slackening, and short time at the steel works is reported. To-day 79s. per ton is quoted for early deliveries of mixed numbers of East Coast hematite pig iron, this being 8s. below the best of the year, and as there is less pressure to sell than has been reported for several weeks, producers are inclined to adhere to the present rates until they can get more relief in the cost of manufacture. Rubio ore has been reduced to 19s. per ton delivered at wharf on Tees or Tyne, this being 2s. 9d. below the best figure of the year. Some cargoes have been sold, however, as low as 18s.

The shipments of pig iron from the Cleveland district this month are disappointing; on foreign account they are much below those of last month, and also of November, 1899. They have reached 56,545 tons, as compared with 63,825 tons last month, and 64,934 tons in November, 1899, all to 21st. The stock of Cleveland pig iron in Connal's warrant stores is naturally increasing, seeing that exports are poor; the quantity held on Wednesday night was 18,440 tons, an increase this month of 2999 tons. The stock of hematite pig iron in the stores still continues at 555 tons, no change having been recorded since the middle of July.

Prices of manufactured iron and steel are still tending downwards. The syndicate of bar iron producers in this district have this week decided to reduce their quotations 10s. per ton, making a decrease of 20s. within a month, and of 30s. since the downward movement commenced. Common iron bars can now be got at £8, best at £8 10s., and double best at £9, less 2½ per cent. f.o.t., but there are firms outside the syndicate who are holding out for more. Steel hoops have been reduced 10s. per ton, and are quoted at £9, less 2½ f.o.t. Steel rail manufacturers are taking almost whatever price they can get, and certainly would not refuse £6 per ton net at works for heavy steel rails, particularly when orders are so few, and competition so keen, that full work can hardly be found at all establishments; indeed, one leading firm have only been running their mills four days per week lately. Plates and angles are steady at the reduced prices announced a fortnight ago, but there is very little doing, and importations of foreign plates are becoming more frequent in Tyneside; as yet only one consignment of foreign plates has been landed in the Tees. Iron and steel ship plates and angles are quoted at £7, less 2½ per cent. at works. Cast iron railway chairs have been reduced to £4 15s. net at works, and steel railway sleepers can readily be bought at £7 10s. net.

An extensive scheme is mooted by a number of leading producers in South and West Durham and Cleveland to supply electricity in bulk in these districts, which contain numerous collieries, ironstone mines, ironworks, railways, engineering works, shipbuilding yards, all of which require power, either steam or electricity. Parliamentary powers are to be applied for. It is stated that it is the intention of the company to have one station near Consett, another near Aycliffe, another at Haverton Hill, another at Skinningrove, and at other points near to collieries, so that fuel may be had as cheaply as possible.

The death took place on Sunday, in London, of Mr. Charles Jesper, the general goods manager of the North-Eastern Railway Company since 1892. He was born in 1854, and began his railway career in 1870 at Darlington. He was afterwards in the mineral manager's office at York, and in 1875 was transferred to the general manager's office, where he remained till 1892.

The Wallsend Slipway and Engineering Company, Limited, has taken the necessary steps to convert its ordinary and preference shares from £10 to £1 each. The Tyne Pontoons and Dry Docks Company is about to follow this example; in fact, a meeting is to be held next Friday.

A syndicate has been formed for the purpose of erecting an aërial bridge across the Tyne between North and South Shields. It is to be 200ft. high, with a clear span of 640ft. There will be a platform suspended by cables, and it will travel backwards and forwards, being moved by electricity. S. A. Sadler and Co., the owners of the Malton Colliery, near Lanchester, have constructed an aërial railway for the conveyance of coal from their Hill Top drift to Malton Colliery, a distance of three miles.

The coal trade is not quite so active as for some weeks past, and prices generally are easier, as shipments are not so brisk, and the consumption for industrial purposes at home has fallen off. Best steam coals can now be had at 16s. per ton f.o.b., and small at 8s. 9d. Coking and bunker coals are in considerably less request, and offers to sell are more numerous than for a long time, so that prices are weak, coking coals at 15s., and bunkers—unscreened—at 14s. f.o.b. Coke has also continued to fall, foundry coke being now obtainable at 23s. per ton f.o.b., and blast furnace coke of medium quality at 20s. 6d. delivered on Teesside, which, however, consumers will not pay for next year's delivery.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been a comparatively small business this week in the pig iron warrant market, and prices on the whole have had an easier tendency. Business has taken place in Scotch warrants from 68s. 7½d. to 67s. 10½d. cash, and 68s. 6d. to 68s. 1½d. one month. A quantity of Cumberland warrants was sold at 76s. 3d. for delivery in ten days, business having started at 77s. 9d. for cash. The weakness in the prices of this class of iron is attributed to reports from the West Cumberland and Barrow districts that considerable sales have been effected there at a marked reduction in prices. In the last few days dealers have rather fought shy of hematite, it being not impossible that some speculative *coup* might be in course of preparation. In the Glasgow market there has been scarcely anything doing in Cleveland warrants.

The prices of both Cumberland and Scotch hematite are nominally as before, but it is alleged that business is being done at lower prices in both cases. This is not at all surprising, for the deliveries in some instances are said to be fixed well into the future, when it is anticipated that prices generally are almost certain to be considerably lower than at present.

Prices of Scotch makers' iron are materially lower this week, the decline varying from 6d. to 1s. 6d. per ton. Govan, No. 1, is quoted, f.o.b. at Glasgow, 69s. 6d.; No. 3, 69s.; Carnbroe, No. 1, 72s.; No. 3, 70s.; Clyde, No. 1, 79s. 6d.; No. 3, 69s. 6d.; Gartsherrie and Calder, Nos. 1, 80s. 6d.; Nos. 3, 70s. 6d.; Summerlee, No. 1, 84s.; No. 3, 70s. 6d.; Coltness, No. 1, 87s.; No. 3, 70s. 6d.; Glengarnock, at Ardrossan, No. 1, 80s. 6d.; No. 3, 70s. 6d.; Eglinton, at Ardrossan or Troon, and Dalmellington, at Ayr, Nos. 1, 71s.; Nos. 3, 69s. 6d.; Shotts, at Leith, No. 1, 85s.; No. 3, 71s. 6d.; Carron, at Grangemouth, No. 1, not quoted; No. 3, 72s. per ton.

The stock of pig iron in Glasgow warrant stores has, in the last six days, decreased 1000 tons, the total decrease since the beginning of the year being 172,130, and the stock now amounting to only 73,120 tons.

The shipments of pig iron from Scottish ports in the past week have been 4350 tons, compared with 5387 in the corresponding week of last year. To Italy 435 tons were despatched, Holland 315, Spain and Portugal 290, Australia 261, China and Japan 200, Canada 15, South America 65, India 100, France 150, Germany 184, Belgium 70, other countries 95, the coastwise shipments being 2170, compared with 2519 tons in the same week of last year.

The import trade in both raw and manufactured iron is on the increase, and is attracting a great deal of attention on 'Change and in trade circles generally. We are receiving pig iron from Germany as well as from the United States; but, on the other hand, the Germans are also being called upon to reckon with American imports. The arrivals of Middlesbrough pig iron at Grangemouth in the past week were 4164 tons, an increase of 1275 tons compared with those of the corresponding week; but the total imports of this class of iron since the beginning of the year are 127,308 tons less than in the corresponding period of 1899.

Since last report three additional furnaces have been put on hematite pig iron, and there are now 40 producing hematite, 34 ordinary and 6 basic iron, the total of 80 thus in operation in Scotland comparing with 77 in the preceding week and 82 in the corresponding week of last year.

As regards the finished iron trade, there is a good deal of irregularity in the matter of employment. At some of the works it is scarcely possible to keep men and machinery going, while in other instances there is steady employment. The position of the manufacturing trades as a whole, including the different branches of the foundry trade, is easier, and competition for orders that come into the market appears to be increasing in severity.

Various causes have conspired to give a little more strength to the coal market. The prevalence of much colder weather has quickened the demand for household coals for home consumption, and the business in this department has accordingly assumed a more active condition, arresting, for the time at least, the downward course of prices. In the export branch there has been a little more inquiry, the recent decline in freights giving some encouragement to shippers. The aggregate shipments from Scottish ports in the past week were 205,013 tons, compared with 194,176 tons in the preceding week, and 187,860 in the corresponding week of last year. Main coal is quoted f.o.b. at Glasgow 12s. 6d.; ell, 13s. 6d. to 14s. 6d.; steam, 14s. to 14s. 6d.; splint, 14s. 6d. to 15s. 6d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

I WAS enabled just after the despatch of my report last week to glean and wire the fact that the Admiralty had placed coal orders for a quarter million tons in the Cardiff district. Full particulars are still wanting, but the principal coalowners who have been favoured are the following:—Cory Brothers, 40,000 tons; Ocean Company, 40,000; Glamorgan, 50,000; Cambrian, 30,000; Cyfarthfa, 15,000; North Navigation, 5000; and Great Western, 5000 tons. The remainder of the order has been received by the Dowlais Company, Nixon Company, Locketts, United Nationals, and Hills Plymouth, but the proportions are not given. The prices are 20s. 3d. and 21s. It is understood on 'Change that some of the leading firms, not specified, quoted higher, and were not accepted.

This week the Orient line entered into a contract with a London firm for their usual supply of coal, which is to be, as on former occasions, the Lewis Merthyr Navigation Steam, with a small percentage of North of England coal.

Since my last report there has been a slight falling off in the demand for steam coals, and prices have weakened a little, in greater part owing to delayed tonnage. Coal prophets are, as on every occasion of a critical condition of things, exercising their powers in forecasting the future of steam coal, and while some maintain that a depression is probable, the majority support the view that though it is likely there may be fluctuations in prices to a small extent, it is certain that no great change is at hand. The colliers are now working well, and the output is a large one, and when, as at present, storms delay tonnage, coalowners are inclined for prompt shipment to make abatements. I fully look for a maintenance of prices about the present level, and the contracts now being closed in several quarters support this view. Mid-week, on 'Change, Cardiff, best and seconds were in moderate request. The continued high price of seconds steam is a notable fact. Latest prices are: Best steam, 21s. to 22s.; best seconds, 19s. to 20s.; drys, 18s. 6d. to 19s. 6d.; special smalls, 12s. to 12s. 6d.; best ordinaries, 10s. to 11s.; seconds, 9s. to 9s. 6d.; inferior, from 8s.; best Monmouthshire, 18s. 6d. to 19s. 6d.; seconds, 17s. 9d. to 18s. Cardiff shipment: Best house coal, 23s. to 24s.; No. 3 Rhondda, 18s. 6d. to 19s.; brush, 15s. 6d. to 16s.; small, 13s. 6d. to 14s.; No. 2 Rhondda, 16s. 9d. to 17s.

Swansea quotations:—Anthracite, finest hand-picked, 26s. to 27s.; seconds, 22s. to 23s.; best large, 20s. to 21s. 6d.; red vein, 16s. to 16s. 6d.; rubbly culm, 10s. 6d. to 11s.; steam coal, 20s. to 21s.; seconds, 18s. to 19s.; bunkers, 14s. to 14s. 6d.; small, 9s. to 9s. 6d.; house coal, No. 2 Rhondda, 17s. to 17s. 3d.

Swansea coal shipments last week were above the average, and a fair shipment of anthracite went to the States.

Patent fuel continues in moderate demand at all ports. Swansea's total last week was under 7000 tons, prices 20s. to 21s. Cardiff figures, 21s. to 22s. 6d., according to brand. Coke is slightly lowering. Swansea prices: Furnace, 26s. to 28s.; best foundry, 34s. to 36s.

Cardiff quotations: Furnace, 28s. to 29s.; foundry, 30s. to 32s.; special foundry, 36s. to 38s.

The importation of steel bars and billets from America is on the increase. Last week a cargo of 2000 tons tin-plate bars came into Swansea, a large portion of which, I hear, was for one of the Morristown tin-plate works. A cargo of 1562 tons steel billets was also received at Newport (Mon.), and 300 tons steel angles from Glasgow. One of the important consignments of the week was 5000 tons of manganese ore from Stratoni for the Pyle and Blaina works. The effect on local industries of the American competition is shown by the partial stoppages at various works—Tredegar, Briton Ferry, and Swansea. At Dowlais the prospects are slightly better. The Siemens smelting furnace was again fired mid-week, and there is increased activity in small goods. The bar mill remains idle, but the "big mill" and the goat mill are in regular work. At Briton Ferry works notices to terminate mature December 11th. Last week only six smelting furnaces were at work. Tin mills are turning out an average quantity. In the Swansea district last week the make was very good, totalling 65,043 boxes. Shipments were limited, only 32,044 boxes. Present stocks 149,202 boxes.

This week another large cargo of steel plates came to Newport from Philadelphia, 2640 tons. Amongst the exports were 290 tons of steel angles for Glasgow, and from Cardiff 1000 tons rails for Natal. Ironmasters are looking forward hopefully to increased rail demands from South Africa, and in the matter of quality and price I am assured on excellent authority that Welsh ironmasters can hold their own.

In the Swansea district this week I was pleased to find a more hopeful view retained of the steel question. One authority observed that the prices of steel tin-plate bars had been brought down to a point that will compete with the American bar, without, he added, its very many disadvantages as to delivery and quality, and at these prices the question of competition will be at an end for the present, as there will be no further inducement to import.

'Change, Swansea, has been well attended this week. There has been a reduction on the past week of 1s. 3½d. per ton in Scotch pig, 1s. 3d. in Middlesbrough, and 2s. 3d. in hematite. Shipments show a falling off.

Latest quotations are as follows:—Glasgow pig iron warrants, 68s. 1d. for cash; Middlesbrough, No. 3, 64s. 3d.; hematite warrants, 77s. 3d. for mixed numbers, Welsh hematite, 80s.; Welsh bars, £8 7s. 6d. to £8 10s.; sheet iron, £8 15s. to £8 17s. 6d.; steel sheets, £8 17s. 6d. to £9; steel rail, heavy sections, £6 5s. to £6 10s.; light, £7 10s. to £8 5s. Bessemer steel tin-plate bars, £5 5s. to £5 7s. 6d.; Siemens best, £5 10s. to £5 12s. 6d. With reference to these low figures it must be noted that the present reduction has been long anticipated, and a further reduction in cost, ore, coal, coke, &c., is needed to enable manufacturers even to hold their own.

Tin-plates, Bessemer steel cokes, 13s. 6d. to 13s. 9d.; Siemens, 13s. 9d. to 14s.; ternes, per double box, 28 by 20 C., 25s., 27s., to 29s. 6d.; best charcoal, 15s. 6d. to 16s.; big sheets for galvanising, 6ft. by 3ft. by 30 g., £11 10s. per ton; finished black plate, £10 10s. Canadas, £13 to £14. Block tin, £127 to £126. Spelter, £19 5s. Copper, Chili bars, £72 5s. to £73. Lead, £17 7s. 6d. Iron ores, Tafna, 17s. 6d.; Rubio, 18s. Cardiff and Newport quotations, best Rubio, 18s. to 18s. 6d. c.i.f.

The upper part of the Swansea Valley is active this week. The new sulphate of copper establishment at Llansamlet will shortly have their own electric light, the plant being nearly ready. The towns of Ebbw Vale and Tredegar are going in for electric powers.

Pitwood is in good demand.

I regret to announce the death of an old authority in the iron world of Wales, Mr. Wm. Thomas, Cardiff. He was connected at one time with Treforest Works, then with Landore, Wearnale, and Marshfield Works, Llanelly. Some years ago he left Wales for Spain, California, and Mexico, in connection with various industries, returning finally to Wales.

It is stated in trustworthy quarters that in the whole of Monmouthshire and South Wales, a large decrease has taken place in the number of men employed in the South Wales steel trade in connection with tin-plate bar manufacture. Out of some twenty steel mills nine are idle, another nine partially going, and only two fully at work. This, it is said, is due almost entirely to the importation of American tin-plate bars. The number of mills working at Welsh tin-plates last month was about the same as in September, but compared with the corresponding month of last year, were less by 58. In October 40 works were running, with 216 mills fully going, but at 35 other works, with a total of 223 mills, only 141 were at work. In the matter of black plate, in September 5211 tons were shipped, and in October 5740.

NOTES FROM GERMANY.

(From our own Correspondent.)

DURING the past week activity in the various iron trades over here has been very moderate. In some special cases a tendency toward improvement could be noticed, but the general condition of the iron market in Rheinland-Westphalia and in Silesia must be regarded as unsatisfactory and dull. The iron ore trade, too, is very quiet; no new sales on home account have been effected during the past few weeks, the mines having previously disposed of their output. There is, however, a fairly regular export business done, and so stocks have only shown a slight increase. The demand for crude iron remains limited as before, and prices have not met with a change, but they are naturally wanting in firmness, and are generally expected to move further downward during the next months. Offers in billets and blooms have been increasing; the new steel works in Luxemburg and Lorraine try to sell at considerably reduced rates, but the most tempting offers fail to induce manufacturers to buy more than they are sure to require in the immediate future, and stocks at the steel works have consequently been rapidly increasing. Negotiations concerning the prolongation of the billet and girder convention have not yet been concluded, but they are likely to end satisfactorily. Scrap iron continues in exceedingly dull request, and as offers increase prices have naturally been moving further downwards, M. 54 p.t. being quoted for scrap iron from the rolling mills, while old iron rails fetch M. 65 p.t. Activity at the bar mills continues very moderate, and the number of orders booked is small. Quotations are fluctuating; officially, M. 160 to 165 p.t. is quoted for iron bars, and bars in basic stand on M. 140 p.t., but makers do not hesitate to accept lower prices. According to the *Rhenish-Westphalian Gazette*, M. 142 p.t. was quoted at a recent tendering at Berlin for bars in iron, while bars in basic only realised M. 118 p.t. The employment of the hoop mills is weak, and the price of M. 195 p.t. may be regarded as nominal. Basis prices for plates have been considerably reduced; plates in basic, for instance, fetch M. 35 p.t. less than before. The occupation of the plate and sheet mills, which is at present anything but lively, will probably improve before long, as large orders for shipbuilding material will be given out; besides, heavy lots of plates will be required for the construction of the 480 locomotives recently ordered by the Prussian State Railway Administration. Prices are varying between M. 225 and M. 255 p.t., according to quality.

For girders next to no inquiry is coming forward, and stocks increase. A very moderate business is done in wire. In order to enable the mills to secure more foreign contracts the wire rod convention has, according to the *Rhenish-Westphalian Gazette*, granted a bounty of M. 20 p.t. for export orders. Inland quotation for wire rods is still M. 185 p.t. as before, but the business done on home account is extremely limited, and with regard to foreign trade only those mills that have their own steel works can hope to do any business with foreign customers, present quotations being so low that if the mills have to buy their supplies in billets they lose instead of gaining by export orders. The wire nail trade is in a deplorable condition, export showing a considerable decrease against the previous year. The German State Railway Administration having given out orders for 800 passenger and about 8000 load wagons, prospects in the engineering and wagon-building department are decidedly bright.

The German coal trade is as firm as ever, and supplies have been smaller than was desirable in many instances, although the number of colliers has been increasing lately, and production last month was considerably higher than in previous months. Prices are very stiff; only for export orders concessions are being granted, and the contracts for the Swiss railways have been accepted at M. 6·40 p.t. less than was previously quoted, which has led to the conclusion that the syndicate expects the tendency of the coal market to be decreasing before long, and that they, therefore, wish to secure as many foreign orders as possible.

An exceptionally dull tone has characterised the Belgian iron market for some time past, and the business transacted upon the week was limited in the extreme. Crude iron is particularly weak; as yet no orders for 1901 have been secured, all the contracts booked being for immediate delivery and of very small weight. Output in pig iron has shown a falling-off, several blast furnaces having been blown out lately. From week to week the prices for malleable iron are decreasing; merchant bars are said to have been sold at 150f. p.t., and girders are now standing at 150f. to 150·50f. p.t. A recent tendering for supplies for the Belgian State Railways has clearly shown how dull the present state of the iron market is. Iron plates, which were ranging between 280f. to 300f. p.t. last year, have been decreasing nearly 50 per cent. The steel works Providence offered 20 tons sectional iron No. 2 at 230f., and 50 tons steel at 200f. p.t.; the steel works Angleur offered 45 tons sectional iron No. 3 at 169f., and 130 tons angles at the same price. The lowest offers, however, were those of the Ougrée Steel Works, which, owning blast furnaces and ore mines, have, by purchasing the colliery Marihaye, likewise secured their requirements in coal, and are therefore enabled to offer at the following exceptionally low rates:—100 tons plates, No. 6, at 167f.; four lots, at 100 tons each, iron plates, No. 3, at 159f.; 150 tons raw plates at 159f.; one lot of 90 tons and another of 50 tons iron plates, No. 4, at 167·40f., all per ton.

The above quotations are all much lower than those of former months, and also considerably lower than last year's prices, as may be seen from the following:—

	Francs.		Francs.
Luxemburg forge pig, No. 3	90	against	105
Charleroi ,, ,, ...	85	,,	90
Basic	100	,,	100
Iron bars, No. 2, f.o.b. Antwerp	150	,,	200
,, ,, No. 3 ,, ...	155	,,	205
Iron plates, No. 2, for export	165	,,	225
,, ,, No. 2, for home consumption ..	165	,,	225
,, ,, No. 3, for export	180	,,	240
,, ,, No. 3, for home consumption ..	185	,,	245

No German works had sent in offers for plates at the tendering above mentioned, but Glückauf in Dahlhausen, and Krupp-Essen, have secured orders for axles. The colliers' strike in North France, though ending much sooner than was expected, has yet been the means of reducing stocks of coal, which had been increasing at the Belgian coal pits. Coalmasters are again anticipating a brisk trade, their chief excuse for anxiety now being German competition; the prices at present quoted by the German coal convention are so low that the surplus in the German output of coal could be easily disposed of in Belgium without reducing the list rates. Two of the most important collieries in the Mons district are reported to have offered a reduction of 2f. p.t. to their customers under condition that they should sign contracts at this price for three months—November, December, January—but owing to the unfavourable condition of the iron business, the ironworks have refused to accept the proposal.

During the first nine months of present year 9,391,420 t. of coal have been exported from Belgium to France, against 7,679,350 t. for the corresponding period of last year.

The production of foundry pig in Russia, during the first two quarters of present year, is stated to have been 87,367,527 pud, against 81,551,309 pud for the same period last year. Import in foundry pig to Russia was, during the period above mentioned, 1,552,000 pud, against 3,422,000 pud in 1899; in malleable iron 2,984,000 pud were imported, against 9,246,000 pud, and in steel 705,000 pud, against 1,254,000 pud; import in finished articles and in machines was 4,606,000 pud, against 6,075,000 pud for the same period last year.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, November 12th.

THE most pronounced effect of the political contest through which this country has passed is to create an enormous demand for stocks, in which railroads and industrials lead. The general industrial expansion and the upward turn of prices has imparted more confidence to industrial stocks than has existed for many months. For two years past most banks have regarded industrial collateral securities as of but little value. A change has come, and well-known industrial securities are now accepted for loans at 4½ per cent. The upward trend will probably be maintained for an indefinite period. There is an abundance of money, and investing enterprise is aroused. Prices have receded as far as they are likely to, and an upward tendency is at work all along the line. Bankers are cautious, but they have more faith in industrial ventures. Bonds are in active demand. New and good securities are being listed, but withal there is nothing like a speculative mania appearing. The export trade is large, exports of breadstuffs for October being 21,913,832 dols., and for ten months 196,443,980 dols.; provisions, 141,370,934 dols.; cotton, ten months, 228,290,634 dols.

The steel makers are in high glee over the sudden demand which has set in during the past few weeks for mill and furnace products. But they are not out of the wood. A great deal of demand has been held back for months owing to two reasons, the declining prices and the uncertainty as to the outcome of the election. The country has recovered from doubt. Its policy has been reasserted. The Republican policy will be rigidly mantained. Its majority was sweeping. There are signs of further trade combinations, especially among steel makers. The plate steel makers combine is the last. The outlook to-day, according to the statements of three of the great combinations' managers, was much better, and a very busy winter awaits all manufacturers, not only in the iron and steel industry but outside of it. At the same time large buyers have not taken alarm over the rumours that prices of steel products are to advance as they did last year. Productive capacity has been largely increased, and combinations now extend their guiding hand into nearly every avenue of productive enterprise.

A combination of ocean steamship companies is now in course of organisation, and will be world-wide. The Red Star Line of eight ships will be purchased, and probably the Pacific Mail Steamship Company. The ships of the Atlantic Transport Company will also be purchased. They have four very large vessels under construction, two at Belfast and two on this side of the water, at Sparrow Point, Maryland. The greatest possible activity prevails in American shipyards, and new yards are projected. The Carnegie Company will ship a very large proportion—if not all—of its exports of steel in its own ships from Conneaut, a lake port 150 miles north of Pittsburgh, reached by the Bessemer road, to Europe, and be independent of railroad rates, which are regarded as excessive.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal market firm for large, but smalls are easier. House coal quiet, owing to want of tonnage. Exports for week ending November 17th were:—Coal, foreign, 61,011; coastwise, 14,216 tons. Imports for week ending November 20th were:—Iron ore, 1850 tons; manganese, 5000 tons; pig iron, 395 tons; steel bars, 4202 tons; pitwood, 3735 loads.

Coal:—Best steam, 19s. 6d.; seconds, 18s. 6d.; house coal, best, 22s.; dock screenings, 10s.; colliery small, 8s. 6d. to 9s. Pig iron:—Scotch warrants, 67s. 4d.; hematite warrants, 76s. 1d. f.o.b. Cumberland; Middlesbrough, No. 3, 63s. 6d. prompt. Iron ore:—Rubio, 18s. to 18s. 6d.; Tafna, 17s. to 17s. 6d. Steel:—Rails, heavy sections, £6 5s. to £6 10s.; light ditto, £7 10s. to £8 f.o.b. Bessemer steel tin-plate bars, £5 5s. to £5 7s. 6d.; Siemens steel tin-plate bars, £5 10s. to £5 12s. 6d., all delivered in the district, cash. Tin-plates:—Bessemer steel, coke, 13s. 6d. to 13s. 9d. nominal; Siemens, coke finish, 13s. 9d. to 14s. nominal. Pitwood, 19s. to 19s. 6d. ex ship. London Exchange telegram:—Copper, £72 12s. 6d.; Straits tin, £127 10s. Freights steady.

CATALOGUES.

A. G. Thornton, St. Mary's-street, Manchester. Illustrated catalogue of drawing and surveying instruments and photo tracing materials.—This book contains particulars of new and original appliances.

Lubecker Maschinenbau Gesellschaft, Lubeck. Illustrated pamphlets describing excavators, floating dredgers, elevators, and hopper barges.—The descriptions are printed in three languages, German, English, and French. The sole agent for the United Kingdom is Mr. F. S. Dudgeon, M.I.N.A., 30, Great St. Helens, London.

THE AMALGAMATED SOCIETY OF ENGINEERS has decided to celebrate its jubilee on Saturday, January 5th, 1901. The society was formed on January 6th, 1851. It has recently built new offices in Peckham, South London, and the jubilee celebration will take place there.

SOCIETY OF ARTS.—In consequence of the annual dinner of the Institution of Electrical Engineers being fixed for Monday, the 3rd of December, the second lecture of Professor Fleming's Cantor course on "Electric Oscillations and Electric Waves," announced for that date, will be postponed until the following day, Tuesday, December 4th, at eight o'clock. The Juvenile lectures will be given this session on the afternoons of Wednesday, January 2nd and 9th, by Mr. E. Walter Maunder, F.R.A.S., Superintendent of the Solar Department, Greenwich Observatory. The subject of the course will be "Eclipses."

GLASGOW'S WATER SUPPLY.

In the course of a lecture on "The Glasgow Waterworks," delivered last week in Glasgow by Mr. Robert Wilson, treasurer of the Water Department of Glasgow Corporation, under the auspices of the District Council of the National Registration of Plumbers, and also in the course of a second lecture on "Glasgow's Water Supply," given by the same gentleman, as one of a series on municipal undertakings, which has been arranged by the Corporation to be delivered during the winter months, some interesting facts were presented as to the introduction and growth of Glasgow's water supply. Prior to 1804 Glasgow had to depend on the public wells for the supply of water. The population was 90,000, and there were only some thirty public wells. In that year an enterprising Glasgow citizen started waterworks, and drove large barrels of water through the streets, for which he got a ready sale. In fact, the demand for the water was so great that it yielded him about £4000 per annum. He also fitted up hot and cold water baths in Bath-street, from which this well-known street derived its name. In 1806 the Glasgow Water Company was formed, and power granted from Parliament to get a supply of water from the Clyde. In 1808 a rival company started, but in 1838 both companies amalgamated.

The lecturer then traced the gradual growth of the works, and referred to the great opposition and expense incurred before Loch Katrine water was introduced in 1859. On the 14th October of that year Queen Victoria performed the opening ceremony at Loch Katrine, and in March of the following year the water supply was general throughout the city. The new aqueduct in course of construction, which the lecturer explained in detail, is 12ft. wide by 9ft. high. The total length will be 23½ miles, and already 22¼ miles are completed, and the remaining 1¼ miles are expected to be finished next summer. When both the old and new aqueducts are available, they will be capable of conveying 110,000,000 gallons per day. Should Loch Katrine and Loch Arklet not provide this quantity, if it ever comes to be required additional water can be brought into Loch Katrine from the smaller Loch Voil and Loch Doine; in fact, an almost inexhaustible supply can be obtained further north and brought into Loch Katrine. The average quantity brought daily from Loch Katrine at present is 51,000,000 gallons, sufficient to fill a canal 30ft. wide by 6ft. deep for a distance of nine miles. The cost of tunnelling through rocks was from £27,000 to £30,000 per mile. The new reservoir and the embankment, to meet the augmented supply by the new aqueduct, was at first estimated to cost about £130,000, but before the work was completed the cost had mounted to £316,000, the increase being largely accounted for by the extraordinary character of the work in connection with the embankment. Trenches had to be cut from 60ft. to 200ft. below the surface of the ground, and laid with layers of puddled clay to prevent the water being lost. The area of distribution of the water supply extended a distance of eleven miles from east to west and of fifteen miles from north to south. The quantity of water drawn last year was 50 million gallons per day from Loch Katrine works and five million gallons per day from the Gorbals works. The population supplied at present was 1,032,000. The revenue last year was £212,000, of which £65,000 was drawn from rates on houses, £125,000 from manufacturers, &c., and £19,200 from the public water rate, which is a tax on landlords. The money expended on all the new works was £3,840,000, of which £1,300,000 had been spent on the new reservoir and aqueduct works. The debt was being paid off at the rate of £60,000 per annum, and already £1,014,000 had been paid. The entire debt of the old aqueduct and works would be extinguished in 1925, and the debt of the new aqueduct would be paid off by 1950. The water-rate on houses in the city, which was 1s. 4d. per £1 in the years 1862-63 and 1863-64, had been reduced to 5d. per £1, and manufacturers, who paid 1s. per 1000 gallons, now paid a fraction over 3½d. per 1000 gallons.

LAUNCHES AND TRIAL TRIPS.

Penare, steel screw steamer; built by, Ropner and Son, Stockton-on-Tees; to the order of, R. B. Chellew, Esq., of Truro; dimensions, 336ft., 48ft., and 24ft. 3in.; to carry, about 5200 tons deadweight; engines, triple-expansion, indicating about 1200 horse-power, pressure 160 lb.; constructed by, Blair and Co., Limited; trial trip, November 19th; 11 knots.

Westminster Bridge, steel screw steamer; built by, William Gray and Co., Limited; to the order of, Bridge Steam Shipping Company, Limited; dimensions, 341ft., 47ft., and 27ft. 4in.; engines, triple-expansion, 25in., 40in., 65in. by 42in., pressure 160 lb.; constructed by, Central Marine Engine Works; trial trip, November 13th; 11½ knots.

TRADE AND BUSINESS ANNOUNCEMENTS.

David Bridge and Co., engineers and millwrights, have removed the whole of their plant from King-street, Salford, and Tomlinson-street, Manchester, to their new works, Castleton, Rochdale.

Charles Neat and Co., 112, Queen Victoria-street, have sold, under the instructions of the United States Commissioner, the United States exhibition building at Vincennes, with the entire plant, engines, boilers, 30-ton electric crane, &c., complete just as it stands.

The Midland Railway Company has appointed Mr. J. Rawson, chief canvasser, Goods Department, Derby, to an important post in London, that of chief city representative, consequent upon the death of Mr. Joseph Heaton. Mr. Rawson has been in the service of the Midland Company since 1864, when he commenced as junior goods clerk at Kirkstall Forge, near Leeds.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

8th November, 1900.

20,073. Purifying Acetylene Gas, G. G. Smith, London.
20,074. Saw Benches, W. Frost, Rochdale.
20,075. Clutch for Cycle Carriages, G. H. Banister, Woolwich.
20,076. Fringing Machines, R. G. Woodland London.
20,077. Box, J. R. Green and J. E. Wain, Birmingham.
20,078. Tire for Wheels of Vehicles, S. Mockett, London.
20,079. Bags, M. Steel, sen., M. Steel, jun., and J. Steel, Newcastle-on-Tyne.
20,080. Incandescent Gas Burners, E. Ward, Southampton.
20,081. Machines for Planing Wood, N. Tailby, London.
20,082. Bolt and Lock Nut, R. and T. Ford, Manchester.
20,083. Match-striking Device, W. Garthwaite, Huddersfield.
20,084. Looms for Weaving, W. Paton, Huddersfield.
20,085. Appliances for Music Stools, E. Ball, Walsall.
20,086. Marking Tickets, E. S. Whittington, Prestwich, near Manchester.
20,087. Cycle Handle-bar and Lamp, A. Goddard, Leicester.
20,088. Explosive Rotary Engine, C. P. Clayton, Southampton.
20,089. Otter Trawl Boards, J. Baxter, Glasgow.
20,090. Condensing Steam Engines, J. Murrie, Glasgow.
20,091. Power-transmitting Clutches, H. Christian, Bradford.
20,092. Coupling for Railway Cars, A. H. Gosling, Southampton.
20,093. Sash, C. F. Pulford, Daybrook, Nottinghamshire.
20,094. Rotary Fluid Prime Movers, J. Ogg, Dundee.
20,095. Machines for Sawing Stone, W. Smith, Keighley.
20,096. Device for Rearing Chickens, I. A. Helliwell, Keighley.
20,097. Door Knobs, T. H. Blenkin and S. G. Ward, Wolverhampton.
20,098. Bearings of Blinds, C. Smith, Bristol.
20,099. Raising of Sashes, J. MacKenzie, Bristol.
20,100. Soap Holders, C. E. Corbitt, Manchester.
20,101. Cork-drawing Machines, J. P. Jackson, Liverpool.
20,102. Fireproof Doors, J. Page, Southampton.
20,103. Sighting Rifles, L. B. Taylor, Birmingham.
20,104. The Dexion, W. C. Lindsay, Glasgow.
20,105. Cooling Air, J. Munk, Berlin.
20,106. Imitation Horses, C. D. Woodburn, London.
20,107. Portable Walls, H. B. Copeland, London.
20,108. Planetarians, J. M. Jones, London.
20,109. Cocks, W. H. Bushell and L. R. S. Tomalin, London.
20,110. Safety Swinging Arm for Electric Wires, H. G. Thomas, London.
20,111. Forage Weighing Machine, G. Choat, London.
20,112. Induction Electric Telephony, J. R. Quain, London.
20,113. Travelling Bag Frames, J. Buck, Manchester.
20,114. Self-driving Sewing Machine, R. G. M. Browne, Sevenoaks.
20,115. Aerial Apparatus, A. H. P. Blunt, London.
20,116. Duplex Spring Clip Chain Coupling, E. E. Pengelly and E. Phillips, Birmingham.
20,117. Furnaces for Steam Boilers, J. Milton, London.
20,118. Cartridge Carriers, W. Lindsey, London.
20,119. Portable Warehouse Elevators, E. Brown, London.
20,120. Studs, F. V. Raymond, London.
20,121. Cases for Holding Cigarettes, B. Bloom, London.
20,122. Bead-threading Machines, A. R. Durante, Kingston-Thames.
20,123. Pumps, E. K. Smith, I. A. Kutch, and J. H. Nunn, Kingston-on-Thames.
20,124. Printing Machinery, E. S. Day, Ash Vale.
20,125. Hatchway Cover Fastening, M. Mulholland, London.
20,126. Making Hats, La Société Tirard Freres, London.
20,127. Spinning Mules or Twining Mills, C. J. Selosse, London.
20,128. Ring-spinning Machines, P. P. Craven, London.
20,129. Elastic Tires, J. A. Mays, London.
20,130. Parquetry, H. P. Clemetson, London.
20,131. Fastenings for Busks of Corsets, C. Libron, London.
20,132. Valves, J. Hopkinson, J. Lowis, and J. Hopkinson and Co., Ltd., London.
20,133. Priming for Percussion Caps, M. Bielefeld, London.
20,134. Match Stands, J. C. Mewburn.—(*E. Treunet, France.*)
20,135. Control of Trains, E. H. Tyler and A. G. Hansard, London.
20,136. Dyeing Machine, J. T. Morgan and W. Menzies, London
20,137. Dividing Dough, G. F. Chutter and F. J. G. Rainbow, London.
20,138. Clock, J. Jerger, London.
20,139. Telephones, J. P. Pehrson and G. A. Betulander, London.
20,140. Apparatus for Dyeing Yarn, R. F. Schüle, London.
20,141. Machines for Mowing Grass, W. Y. Lister, London.
20,142. Coating Aluminium, H. H. Lake.—(*A. G. Betts, United States.*)
20,143. Lamps, A. J. Boult.—(*K. M. Seifert and Co., Germany.*)
20,144. Crystallisation of Salts, L. Kaufmann, London.
20,145. Manufacturing Bottle Capsules, A. Fridler, London.
20,146. Telephones, F. Oprendek and L. Röder, London.
20,147. Motor Cars, J. H. Toulmin, W. Norris, and T. Coulthard, jun., London.
20,148. Callipers, C. A. Hucstis, London.
20,149. Internal Combustion Engines, L. Genty, London.

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20,150. Steam Traps, W. H. and R. Thompson, London.
20,151. Moulding Bricks, R. McCully, Whitehead, Co. Antrim.
20,152. Igniting Devices, J. Ridley and G. Gibson, Birkenhead.
20,153. Rotary Clutches, S. Cowper-Coles, London.
20,154. Non-propeller Ship Driver, F. C. Homer, Stoke-on-Trent.
20,155. Treating Flax, A. J. Davidson, Crossgar, Co. Down.
20,156. Cigarette-making Machine, N. Boyadgen, Newcastle-on-Tyne.
20,157. Brakes for Velocipedes, J. W. Bayliss, Coventry.
20,158. Apparatus for Treating Yarn, C. Hartley, Manchester.
20,159. Apparatus for Dyeing Yarn, C. Hartley, Manchester.
20,160. Draining Water from Umbrellas, H. J. Milward, Redditch.
20,161. Cycle Bells, H. Lucas and A. C. Davidson, London.
20,162. Water Heater for Motor Cars, T. H. Brough, London.
20,163. Heating Steam, A. Bolton and R. Anderton, Manchester.
20,164. Practising Golf Indoors, E. Crowe, Banbury.
20,165. Decorating Tiles, A. H. and E. R. Corn, Stoke-on-Trent.
20,166. Expressing Liquid from Peat, C. Whittaker and Co. (1900), Limited, and L. Whittaker, Liverpool.
20,167. Reversible Seat Bottoms, W. McPherson and W. H. Henry, Glasgow.
20,168. Gas Reversing Valve, E. J. W. Richards and R. Marshall, Glasgow.
20,169. Music Turner, C. A. V. Anderson, Douglas, Isle of Man.
20,170. Cultivators, J. Arres-Mather, Glasgow.
20,171. Steam Generators, J. Murrie, Glasgow.
20,172. Back-pedalling Brake, O. Pihlfeldt, Birmingham.
20,173. Railway Wagon Coupling, H. J. Piper, Bourn, Cambs.
20,174. Free-wheel Clutches for Cycles, C. A. Hyde, Birmingham.
20,175. India-rubber Mats, A. Whiteway and C. Macintosh and Co., Limited, Manchester.
20,176. The "Martin" Terminal, H. S. Martin, Liverpool.
20,177. Collector for Electrical Purposes, E. Batault, London.
20,178. Moulds for Casting Type, E. Maruhn and E. Uhthoff, London.
20,179. Electric Arc Lamps, E. R. Smith, J. J. Rathbone, and C. B. King, jun., London.
20,180. Supporting Photographic Cameras, R. W. Shipway, London.
20,181. Platen Printing Machines, T. Forknall, London.
20,182. Lamps of Incubators, W. Tamlin, London.
20,183. Apparatus for Wrapping Chocolate, H. Rose, London.
20,184. Metal Polish, E. L. Jennings, London.
20,185. Syphon Flushing Cisterns, H. F. Hill, Nottingham.
20,186. Air Brakes, C. D. Abel.—(*Siemens and Halske Aktien-Gesellschaft, Germany.*)
20,187. Rifle Back-sight, A. N. D. and A. Smith, London.
20,188. Expanding Bungs for Barrels, E. C. Phillips, London.
20,189. Cotton Bobbins, H. Taylor, London.
20,190. Cheese Cutters, G. T. Clarke, London.
20,191. Dummy Bayonet Rifles, G. M. Fox, London.
20,192. Apparatus for Saving Life at Sea, P. L. Boulant, London.
20,193. Propulsion of Cycles, G. B. H. Austin, London.
20,194. Compounds for Use in Agriculture, G. H. Richards, London.
20,195. Baths for Photographic Purposes, H. S. Morgan, London.
20,196. Apparatus for Drying Seed, W. Jäger, London.
20,197. Troughs for Electric Mains, M. Lachman, London.
20,198. Puzzle Device, A. M. Chapin, London.
20,199. Protecting Typewriter Keys, The Yöst Typewriter Company, Limited, and M. Bartholomew, London.
20,200. Electrolytic Cells, J. H. Noble and A. Motty, Liverpool.
20,201. Covering Electric Conductors, G. E Heyldin, Liverpool.
20,202. Grinding Broad Knives, W. Rowlandson, Liverpool.
20,203. Bung for Barrels, J. Hart and J. Worth, Liverpool.
20,204. Furnaces, E. and A. W. Bennis and J. R. Hannan, Manchester.
20,205. Treating Fluids, H. Desrumaux and J. T. Norman, London.
20,206. Powder Puffs, V. L. M. Renard, Kingston-on-Thames.
20,207. Bedsteads, G. H. McBride, Kingston-on-Thames.
20,208. Mechanism for Transmitting Power, J. Dring, London.
20,209. Apparatus for Making Boots, E. Field, London.
20,210. Vapour-burning Apparatus, A. Kitson, London.
20,211. Sealing Devices or Closures, W. E. Heath, London.
20,212. Braces for Suspending Trousers, G. McConnell, Leeds.
20,213. Brakes, U. de Civry, London.
20,214. Electric Lighting Cane, T. Bergmann, London.
20,215. Producing Alimentary Meal, H. M. M. Barré, London.
20,216. Mercurial Centrifugal Pump, F. de Mare, London.
20,217. Checks for Doors, H. H. Lake.—(*E. Blamey, United States.*)
20,218. Making Paving Blocks, J. Hutchison, London.
20,219. Ventilating Drains, I. Shone and E. Ault, London.
20,220. Elastic Tires for Cycles, W. F. Williams, London.
20,221. Bottles, W. Henzenberger, London.
20,222. Air Vessels for Force Pumps, H. Lapp, London.
20,223. Switches for Railways, F. Voigtlaender, London.
20,224. Envelope, L. M. Silverwood, London.
20,225. Bicycles, N. Nesmayanoff, London.
20,226. Focussing Lenses of Cameras, H. P. Tattersall, London.

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20,227. Covers for Pneumatic Tires, W. A. Griffiths, Birmingham.
20,228. Scoop, M. B. Wohlleben, London.
20,229. Acetylene Gas Generators, H. Shepherd, Burnley.
20,230. Photographic Plate-washing Rack, E. M. Rosher, Haslemere, Surrey.
20,231. Electrical Connections, R. F. Hall, Birmingham.
20,232. Construction of Cycle Lamps, F. J. Miller, Birmingham.
20,233. Method of Propelling Ships, M. Meehan, Darlington.
20,234. Protecting Guard for Machines, W. McAuslan, Glasgow.
20,235. Guard for Circular Saws, J. Whittle, Manchester.
20,236. Jacquard Machines, D. Wright and A. Flather and Sons, Limited, Bradford.
20,237. Binding Documents Together, A. N. Dunlop, Glasgow.
20,238. Umbrella Holder for Carriages, J. B. Cowan, Dundee.
20,239. Heating and Ventilating Apparatus, J. Keith, Glasgow.
20,240. Hooks and Eyes, J. McFarlane and W. Hall, Glasgow.
20,241. Umbrella Holder, E. Schwindke, Berlin.
20,242. Method of Building Ships, A. Lambie, Glasgow.
20,243. Actuating Expansion Valves, J. G. Barclay, Glasgow.
20,244. Swift Clip, E. I. Pennefather, Bristol.
20,245. Beam Joist, C. Hessel and W. Sippel, Manchester.
20,246. Method of Propelling Ships, A. Hunnable, Romford.
20,247. Method of Propelling Velocipedes, A. Hunnable, Romford.
20,248. Carriage and Wagon Springs, J. Williams, London.
20,249. Acetylene Gas Producer, J. G. Campbell and A. T. Sillars, Belfast.
20,250. Recording Apparatus, A. Hill and J. Tatlock, Glasgow.
20,251. Antiseptic Candles, F. P. Malet and F. Lavignac, London.
20,252. Steamer for Textile Printing, F. A. Hilton, Chorley.
20,253. Lifting Poker Foot Bracket, K. G. Wood, Rochdale.
20,254. Mouthpieces of Tobacco Pipes, A. L. Baines, London.
20,255. Fitting for Electric Ceiling Roses, W. G. Stones, Manchester.
20,256. Swinging Brackets for Electric Lights, A. J. Boult.—(*K. M. Seifert and Co., Germany.*)
20,257. Apparatus for Cooling Air, T. Douglas, London.
20,258. Manufacture of Elastic Tires, W. E. Williams, London.
20,259. Rack for Keeping Bundles of Wood in Place, J. Pattenden, London.
20,260. Billiard Tables, J. R. Mally, London.
20,261. Gas Governors, W. G. Potter, London.
20,262. Extensible Boats, A. Austin, London.
20,263. Chimney Cowl, G. A. Harvey and J. F. East, London.
20,264. Connection for Electric Mains, C. D. Burnet, London.
20,265. Ordnance Sights, Sir W. G. Armstrong, Whitworth, and Co., Ltd., and C. H. Murray, London.
20,266. Alarm Clock, J. J. Haller and Vereinigte Uhrenfabriken von Gebrüder Junghans und T. Haller Actien Gesellschaft, London.
20,267. Explosion Engines, O. Kopp and W. Preston, London.
20,268. Means for Securing Belts, W. Rachler, London.
20,269. Means for Cleansing Steam Boilers, R. Fryer, London.
20,270. Paring and Edge-setting Machine, W. B. Mudd, London.
20,271. Process for Purification of Brine, G. N. Vis, London.
20,272. Elevating Lumber, A. J. Tenow and J. E. Flodström, London.
20,273. Brake Apparatus, W. H. Rymer, Liverpool.
20,274. Improving Combustion in Boilers, R. Schulz, Liverpool.
20,275. Appliance for Incandescent Gas Burners, M. Werthen, London.
20,276. Dyestuffs, O. Imray.—(*Farbwerke vormals Meister, Lucius, and Brüning, Germany*)
20,277. Supporting Lamp Filaments, O. Imray.—(*The Oesterreichische Gasglühlicht-und Electricitäts-Gesellschaft, Germany.*)
20,278. Freight-car Doors, C. Marsden, London.
20,279. Steam Traps, J. E. L. Ogden, London.
20,280. Driving, &c., Gear Wheels, J. Appleby, London.
20,281. Marking Device for Laundries, B. Capper, London.
20,282. Funnels for Filling Bottles, A. S. Rayner, London.
20,283. Free-wheel Action for Cycles, R. L. Ham, Barnstaple.
20,284. Mechanical Stokers for Furnaces, J. Proctor, Burnley.
20,285. Chains for Suspending Lamps, E. Fletcher, Birmingham.
20,286. Brush for Cleaning Bottles, J. W. Nathan, London.
20,287. Steam Turbines, W. T. Carter, London.
20,288. Steam Pile Driver, J. Grapengeter, London.
20,289. Producing Printing Blocks, H. Bogaerts, London.
20,290. Passenger or Goods Elevators, W. H. Aston, London.
20,291. Digging Roads, T. and G. Musto, and J. Jones, London.
20,292. Manufacture of Fishing Nets, C. Zang, London.
20,293. Paper-perforating Appliance, P. L. Deighton, London.
20,294. Machines for Filling Bottles, G. Sands, London.
20,295. Spray-producing Apparatus, A. Bulling, London.
20,296. Case for Reception of Matches, E. A. Gerken, London.
20,297. Operating Barriers in Crossings, H. Siegmann, London.
20,298. Closing Railway Gates, H. Siegmann, London.
20,299. Wheels, W. L. Wise.—(*R. Paulitschky and F. Wüste, Austria.*)
20,300. Padlocks, D. Waine, Birmingham.
20,301. Treatment of Complex Ores, E. H. Hopkins, London.

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20,302. Steering Wheels of Cycles, J. Devey, Wolverhampton.
20,303. Coin-controlled Mechanism, A. C. Wright and H. F. Rogers, London.
20,304. Recovery of Metals from Ores, S. Cowper-Coles, London.
20,305. Manufacture of White Lead, S. Cowper-Coles, London.
20,306. Fixing Tires to Wheels, F. W. Jones, London.
20,307. Driving Ropes, S. J. Rivett, Manchester.
20,308. Manufacture of Metal Caps, A. Rothery, Halifax.
20,309. Oil Container Indicator, C. W. Wimbury, Worcester.
20,310. Dishes Employed in Photography, T. C. Twining, Chorlton-cum-Hardy.
20,311. Electrical Cushions for Tables, O. T. Banks, London.
20,312. Flags for Signalling, G. A. Skinner, Sheffield.
20,313. Conditioning Woollen Tops, J. Wetherill, Batley.
20,314. A Door Lock, J. Sutton and G. Berry, Preston.
20,315. Regulating Consumption of Gas, G. W. Hunter and D. McLaren, Glasgow.
20,316. Miners' Safety Lamps, J. Treharne and D. Roberts, Llanelly.
20,317. Soap Frames, T. B. Bolton, Grangemouth, N.B.
20,318. Fog Signal for Railways, C. Bibb, Birmingham.
20,319. Supplying Air to Fires and Stoves, W. Birch, Sheffield.
20,320. Tenon Joint, A. Pfoil, Berlin.
20,321. Chain Bracelet, A. Kümmerle, Baden, Germany.
20,322. Self-opening Advertising Card, T. Fraser, Birmingham.
20,323. Bath, J. Nuttall and R. Wilson, Heywood, Lancs.
20,324. Apparatus for Raising Blinds, A. W. Read, New Brighton, Cheshire.
20,325. Producing Lace, J. M. and W. G. Eades, Birmingham.
20,326. Coils for Refrigerating Machines, F. W. Norman, Dartford, Kent.
20,327. Interlocking Valve Gear, A. T. Cooper, Reading.
20,328. Pneumatic Tire Valve, H. Oliver, London.
20,329. Connecting Pumps to Tire Valves, H. Oliver, London

20,330. Cycle Rim Brakes, H. Cooper and W. Walker, London.
20,331. Tramcar Seats, J. Tinsdale and C. Maude, London.
20,332. Machines for Dyeing Yarn, W. Coventry, Manchester.
20,333. Apparatus for Domestic Fireplaces, T. Ryding, London.
20,334. Covering for Tramcar Seats, W. H. Thrift, London.
20,335. Fastener for Straps, R. C., E. W., G., and R. T. Bourchier, London.
20,336. Aerostatic Improvements, A. Tietz, London.
20,337. Backs for Lavatory Basins, N. E. Cooke, London.
20,338. Devices for Dressing the Hair, E. Cram, London.
20,339. Bundling Printed Matter, J. F. Phillips, London.
20,340. Brush, S. H. Crocker, London.
20,341. Means for Lighting Gas, C. Carpenter, London.
20,342. Ladies' Corsets, E. Kohler and F. G. Bate, London.
20,343. Shovels, N. G. Robertson, London.
20,344. Engine, J. A. Richards, London.
20,345. Making Cigarettes and Cigars, W. Andrews, London.
20,346. Peat Moss Paper, &c., W. M. Callender, London.
20,347. Refrigerators, T. Douglas and G. Conroy, London.
20,348. Device for Discharging Liquid, R. G. Brooke, London.
20,349. Photographic Objectives, H. Meyer, London.
20,350. Apparatus for Dyeing Yarn, A. Mascheck, London.
20,351. Machine for Drying Peat, J. Westaway, London.
20,352. Devices for Indicating, &c, E. F. Schreier, London.
20,353. Device for Aerating Liquids, M. Kasper, London.
20,354. Culinary Vessels, R. Slee, London.
20,355. Scaffolds, G. Curley, London.
20,356. Tiles for Roofing Purposes, R. Y. Foley, London.
20,357. Portable Electric Lamp, J. McHardy, London.
20,358. Ventilating with Cooled Air, J. A. Hart, London.
20,359. Generating Acetylene Gas, A. Browett, London.
20,360. Cushions, R. Haddan.—(*Meinecke and Co., United States.*)
20,361. Brakes for Street Cars, B. L. Kilgour, London.
20,362. Electric Incandescent Lamps, C. Howard, London.
20,363. Pneumatic Railway Signals, J. P. O'Donnell, London.
20,364. Making Pearl Buttons, H. Wheatcroft, Birmingham.
20,365. Furnaces for Steam Boilers, W. G. Potter, Birmingham.
20,366. Roller Bearings, &c., W. G. Potter, Birmingham.
20,367. Device for Fastening Boxes, J. West, London.
20,368. Flying Machines, F. R. Simms, London.
20,369. Acetylene Gas Generator, H. de Thiersant and W. A. Coulson, London.
20,370. Dividing Butter into Pats, G. J. Kingsbury, London.
20,371. Cash Register, G. Andrew and T. R. Ashworth, London.
20,372. Packing Rabbits in Crates, G. E. Andrew, London.
20,373. Vehicle Wheels, H. Ehrhardt, London.
20,374. Raising and Lowering Loads, A. Schwarze, London.
20,375. Hammer, S. Luke, London.
20,376. Generating Acetylene Gas, W. Sharman, London.
20,377. Drying Yarns, F. Gilli, London.
20,378. Pulley Blocks, B. J. B. Mills.—(*G. Accary, France.*)
20,379. Superheating Device for Boilers, W. Schmidt, London.
20,380. Home Trainer for Cycles, W. O. Wedlake, London.
20,381. Lighting Device for Matches, W. Greenhalgh, London.
20,382. Small-arms, J. S. Foley and J. H. Birch, London.
20,383. Alternating-current Induction Motor, B. G. Lamme, London.
20,384. Electric Distribution System, B. G. Lamme, London.

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20,385. Compressed Air Self-closing Device, H. J. Huggins, London.
20,386. Pole Heads, A. M. Young, London.
20,387. Refrigerating Apparatus, L. Chew, London.
20,388. Production of Low Temperatures, S. Cowper-Coles, London.
20,389. Eye-glasses, C. Sharland, London.
20,390. Signalling in Fogs, J. W. Wood, Birmingham.
20,391. Wire Cut Brick Machines, S. Wragg, Derby.
20,392. Covering Steam Boilers, J. F. Liversedge and W. Haigh, Leeds.
20,393. Holders for Knives, J. Wilson and T. H. Burnett, Manchester.
20,394. Railway Chairs and Rail Couplings, C. Tymm, Manchester.
20,395. Preventing Rain from Coming Under Doors, A. J. Morcom, St. Austell, Cornwall.
20,396. Clacks of Pumps for Liquid, E. Morris, Blackburn.
20,397. Manufacture of Grocers' Bags, I. K. Rogers, Bath.
20,398. Vehicle for Flushing Gullies, J. W. Glover, Warwick.
20,399. Means of Smoking Tobacco, A. E. Harrison and J. F. Payne, Tunstall, Staffs.
20,400. Camp Stool and Holdall, A. W. Seymour, Rugby.
20,401. Rim Brakes, E. Hodgson, Levenshulme, near Manchester.
20,402. Sleeve Top Roll for Coats, W. H. Sladdin, Brighouse, Yorkshire.
20,403. Eyelet Holes for Shirt Fronts, H. R. Denne, London.
20,404. Sewing Machines, B. Skelton and W. R. Edwards, London.
20,405. Cigarette-holding Appliance, W. K. Ferguson, London.
20,406. Sleeve Link, C. J. Harmer, Birmingham.
20,407. Forced Draught Apparatus, R. Robinson, Manchester.
20,408. Separating Solids from Liquors, J. M. Anderson, Glasgow.
20,409. Captive Ball for Golf Practice, J. S. Crowley, Manchester.
20,410. Trimming and Shaping Sand Cores, J. Butler, Manchester.
20,411. Compensating and Flexible Couplings, H. F. Foster, Dover.
20,412. Chemical Gas Engines, F. W. Jackson, Nottingham.
20,413. Decorating Textile Fabrics, E. C. Käyser, Hyde, Cheshire.
20,414. Sewing Machines, J. K. Macdonald.—(*J. J. Sullivan, United States.*)
20,415. Bottle Boxes, S. McCall, Kilmarnock.
20,416. Mowing and Reaping Machines, A. McGregor, Manchester.
20,417. Flyers in Bobbin Frames, W. Berry and J. Scrimgeour, jun., Manchester.
20,418. Self Fitter, A. Ottowski, Brighton.
20,419. Forming Padded Edges for Mattresses, J. Wiesbader, Berlin.
20,420. Coffee Urns, A. and J. Phillips, Glasgow.
20,421. Horseshoe Pads, T. Holme.—(*H. Rasmussen and H. Brandt, Denmark.*)
20,422. Pickle Tongs, L. B. Cousins Lincoln.
20,423. Railway Signalling, J. Roth and W. Helmke, London.
20,424. Furniture, A. G. Brookes.—(*W. Vogler, United States.*)
20,425. Umbrella and Stick Handles, K. J. Nilsson, London.
20,426. Pneumatic Cushion for Cycles, W. Godden, London.
20,427. Water-tube Boilers, A. J. Boult.—(*M. Coryell, United States.*)
20,428 Ratchet and Pawl Mechanism, J. Grant, Liverpool.
20,429. Boxes for Moulding Metal Objects, G. Rufus, Manchester.
20,430. Fabrics, H. Markus, Manchester.
20,431. Pneumatic Tires, A. S. Crosby and J. G. Billings, Birmingham.
20,432. Hubs of Perambulators, L. L'Hollier, Birmingham.
20,433. Brakes for Bicycles, R. F. Keeling, Birmingham.
20,434. Licensed Victualler's Save-all, D. Brown, London.
20,435. Cycle Brakes, W. T. Lord, London.
20,436. Lever Wheel, H. Orley, London.
20,437. Oil Cans, H. Swanton, London.
20,438. Lock-nuts, O. Imray.—(*A. V.-N. Bryce and G. Wix, United States.*)
20,439. Electric Fire-alarms, O. Freymann, London.
20,440. Tooth-powder Box, G. Brewer.—(*W. H. Hall, United States.*)
20,441. Conveying Apparatus, A. Dent and W. R. Grindlay, London.
20,442. Bottle Closures, W. H. Lockhart and G. H. Klein, London.
20,443. Conical Roller Bearings, R. H. and J. McHardy, London.
20,444. Feed-water Heaters, A. G. Hohenstein, London.
20,445. Water-tube Boilers, A. G. Hohenstein, London.
20,446. Wooden Boxes, E. Ames and the Timber Tea Chests Company, Limited, London.
20,447. Brake, The Westinghouse Brake Company, Limited.—(*G. Westinghouse, United States.*)
20,448. Clutch and Reversing Mechanism, H. L. Arnold, London.
20,449. Safes, H. D. Hibbard, London.
20,450. The Game of Flirts, F. J. Randall, London.
20,451. Renewable Seatings for Valves, B. Rhodes, London.
20,452. Hose Reels, E. Cliff and L. D. Jones, London.
20,453. Construction of Ceilings, G. A. Wayss, London.
20,454. Ordnance, J. W. and R. Fryer, and W. Dinsdale, London.
20,455. Roulette, W. E. Christie.—(*Oppenheimer and Sulzbacher, Germany.*)
20,456. Rolling Stock for Railways, R. J. Rae, London.
20,457. Cinematographs, A. Wrench, London.
20,458. Fire-alarms, P. Steins and P. J. Smith, London.
20,459. Lavatory Waste Valves, R. G. Howson, London.
20,460. Pattern-manufacture Apparatus, H. Mackintosh, Liverpool.
20,461. Artificial Filaments, &c., F. Lehner, Liverpool.
20,462. Sealing Buckle for Bags, A. F. Thompson, Liverpool.
20,463. Bottle-closing Apparatus, J. Kroog, London.
20,464. Manufacturing Metal Boxes, S. Opsal, London.
20,465. Water-tube Steam Generators, T. F. Fairlie, Liverpool.
20,466. Exploding Mines, Evershed and Vignoles, Ld., and S. Evershed, London.
20,467. Breeches, W. Foxton, London.
20,468. Steam Boiler Feed-water, D. B. Morison, London.
20,469. Coating Metal Plates, P. Rogers and J. Player, London.
20,470. Fastenings Leggings and Gaiters, W. Foxton, London.
20,471. Connectors for Electric Wires, J. R. Jones, London.
20,472. Warp-spooling Machines, E. Nagler, London.
20,473. Vaporising Apparatus, &c., R. L. Benson, London.
20,474. Mercerising Machines, M. Frings, London.
20,475. Power-transmission Device, R. Schubert, London.
20,476. Vehicle Wheels, J. N. Johnson and G. C. Price, London.

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20,477. Securing of Buttons, W. W. Tambs, Birmingham.
20,478. Air-inlet Tubes of Gas Burners, P. C. Jones, Guildford.
20,479. Fixing Wood-block Floors, F. Parkinson, Little Hulton, near Bolton.
20,480. Writing Pens, W. Moseley and J. L. Crawford, London.
20,481. Knitting Machines, J. Hallam and W. Wheeler, Leicester.
20,482. Supplying Water to Cut Flowers, J. A. Winwood, Manchester.
20,483. Carburetters for Explosion Motors, E. Perks and F. Birch, Coventry.
20,484. Purification of Gas, T. S. Clapham, Keighley.
20,485. Carding Fibrous Substances, J. Totlow and D. Crabtree, Keighley.
20,486. Bending Sheet Metal, W. A. and D. Crabtree and A. Shaw, Keighley.
20,487. Automatic Tinning Machine, J. H. Williams, Abertillery, Mon.
20,488. Machines for Moulding Dough, W. Oatley, London.
20,489. Engine Packing, W. M. Crawford, Bristol.
20,490. Metallic Bedsteads, W. A. Cross and S. R. Caddick, Birmingham.
20,491. Removing the Burr from Bolt Heads, M. Stott, Manchester.
20,492. Window Fasteners, J. Glass, Manchester.
20,493. Distributing Boards for Electrical Circuits, A. M. Taylor and R. Steel, Glasgow.
20,494. "Bridges" for Banjoes, F. Campbell, Southport.
20,495. Holding Material in Embroidery Machines, J. Henderson, Glasgow.
20,496. Securing Knobs to Spindles, H. C. Price, Birmingham.
20,497. Supporting Axles of Motor-propelled Vehicles, W. Biddles, Leicester.
20,498. Warping Machines, J. W. Midgley, Keighley.
20,499. Treatment of Stuffing for Beds, W. H. McNeight, Dublin.
20,500. Kalogon, J. Wakeford, Liverpool.
20,501. Wheels and Brakes of Cycles, B. Poynton and E. Jones, Birmingham.
20,502. Shackles for Tethering Horses, S. J. and H. Hawley, Birmingham.
20,503. Cigar Cutters, A. Miesch, Birmingham.
20,504. Promethean Spirit Lamp, T. Thompson, Edinburgh.
20,505. Pneumatic Tire Protectors, A. Allardice, Glasgow.
20,506. Printing, J. B. Duckett, Sheffield.
20,507. Plugs for Internal Combustion Engines, R. F. Hall, Birmingham.
20,508. Automatic Coin Machines, J. Atterbury, London.
20,509. Hose-pipe Protective for Fires, A. McGlinn, Glasgow.
20,510. Vacuum Tube for X-ray Production, A. E. Dean, London.
20,511. Photographic Plate Holders, P. M. Justice.—(*A. Goffney, United States.*)
20,512. Lubricating Bearings, P. Thömke, London.
20,513. Iron Manufacture, A. Simon, London.
20,514. Fuel Economisers for Stoves, W. G. Potter, Birmingham.
20,515. Fog Signalling, W. J. Gooding, Kingston-on-Thames.
20,516. Cash Registers, J. Schinneller, Kingston-on-Thames.
20,517. Stoves, E. J. M. Bagnall, London.
20,518. Grinding Machines, J. Snow, London.
20,519. Weighing Machine for Grain, G. Rosling, London.
20,520. Pins for Securing Head Gear, W. H. Johnson, London.
20,521. Regulating Pressure in Evaporators, V. I. Feeny.—(*Abteirme Kraftmaschinen-Gesellschaft m. b. H., Germany.*)
20,522. Switches for Electric Currents, The British Thomson-Houston Company, Ltd.—(*E. M. Hewlett, United States.*)
20,523. Unbreakable Washing Buttons, W. Hülsmann, Scarborough.
20,524. Ordnance, J. A., F. E., and M. E. Normand, London.
20,525. Device for Basting Meat, C. E. Cole, London.
20,526. Fasteners for Carpets, G. Holley, London.
20,527. Locking Device, H. Goedecke and E. Freyer, London.
20,528. Paste, W. Häckel, A. Heinrich, and C. Gumpricht, London.
20,529. Spring Bottoms of Bedsteads, P. Albert, London.
20,530. Metallic Bedsteads, G. Whitfield, Birmingham.
20,531. Brakes for Bicycles, G. F. Bull, Birmingham.
20,532. Links for Fastening Shirts, C. F. Hofmann, London.
20,533. Machine for Fleshing Hides, E. Wilson, London.
20,534. Leather-rolling Machines, E. Wilson, London.
20,535. Transmitting Power, B. Willcox.—(*A. L. Riker, United States.*)
20,536. Ice-breaking Vessels, H. C. Clarke, London.
20,537. Revolving Billiard Cue, J. P. Funt, London.
20,538. Metallic Ornamentations, F. F. Scruby, London.
20,539. Metallic Alloys, W. A. Thomas and R. B. Wheatley, London.
20,540. Indicating Movements of a Compass, C. D. Abel.—(*Siemens and Halske Aktien-Gesellschaft, Germany.*)
20,541. Spanners, W. B. Lake and E. F. Elliot, London.

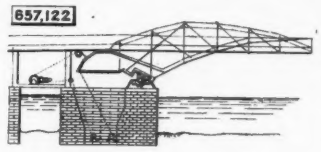
SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

657,122. Lift Bridge, *F. la Pointe, Chicago, Ill.—Filed June 6th*, 1900.

Claim.—(1) The lift or bascule bridge having a limited number of widely-separated centres upon which it is supported and swings in succession while being opened and closed, substantially as specified. (2) The lift or bascule bridge having a limited number of widely-separated centres upon which it is supported and swings in succession while being opened and closed, such centres being provided with antifriction rollers, substantially as specified. (3) The lift or bascule bridge having a limited number of widely-

657,122

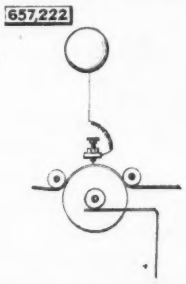


separated centres upon which it is supported and swings in succession while being opened and closed, such centres being located at different levels, substantially as specified. (4) The lift or bascule bridge having three centres on which it swings in succession, the centre pivot being raised above the others, substantially as specified. (5) The lift or bascule bridge having a limited number of widely-separated centres upon which it is supported and swings in succession while being opened and closed, and also having a corresponding number of open sockets with which the several centres may successively engage, substantially as specified.

657,222. Wireless or Space Telegraphy, *J. Kitsee, Philadelphia, Pa.—Filed May 20th*, 1899.

Claim.—In space telegraphy a receiving instrument consisting of a chemically-prepared paper resting on a metallic support connected to the ground in combination with the terminal of the aërial conductor

657,222

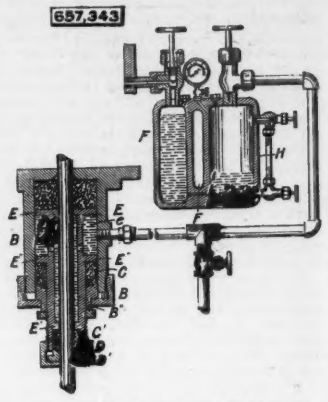


secured in juxtaposition to, but not in actual contact with, said paper, and means for carrying successively, successive parts of said paper between said support and aërial conductor.

657,343. Stuffing-box for Ammonia Compressors, *F. A. Fisher, Provincetown, Mass.—Filed January 29th*, 1900.

Claim.—(1) In an apparatus of the character described, the cylinder; the tubes or chambers F, H, rigidly connected together and provided with the connecting passage F', and suitable inlets, said tube F containing mercury and said tube H oil; a stuffing-box around the piston; a tubular connection between the oil chamber H and the interior of the stuffing-box; and a tubular connection provided with a suitable valve between the mercury chamber and the cylinder, substantially as described. (2) In an apparatus of the character described, the stuffing-box comprising the case B; the sleeve C, C', provided with the inwardly and outwardly-extending flange E, the inwardly-extending flange E', the inwardly-extending flange E'', and the opening e; the gland B'' and the follower B; the gland D' and the follower D; a mercury chamber or tube and an oil chamber or tube connected rigidly together and communicating with each other by a passage; a pipe connection between the interior of the stuffing-box and said oil chamber; a cylinder,

657,343

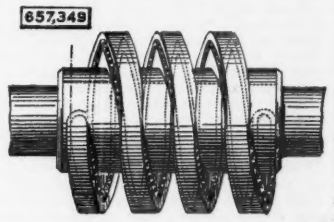


and a pipe connection between said cylinder and the mercury chamber, substantially as set forth.

657,349. Worm Gearing, *C. M. Jones, Philadelphia, Pa.—Filed August 28th*, 1899.

Claim.—A worm provided with continuous channels in opposite sides of the convolutions thereof, and

657,349

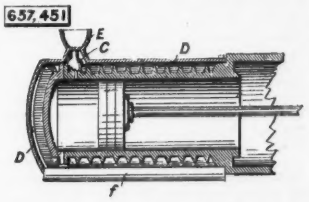


return channels passing from one side to the other in the end convolutions near the terminals thereof, and antifriction devices in said channels.

657,451. Cooling Means for Explosive Engines, *S. W. Rea, Rushville, Ind.—Filed April 14th*, 1900.

Claim.—In a cooling device for explosive engines, the combination with the cylinder having webs around the same and across the end or head, and an exhaust valve C projecting from one side of said cylinder; of a jacket D inclosing the cylinder and having a tapered

657,451



inlet opening *f* extending longitudinally at one side thereof and formed by slitting the jacket and bending the edges back, the wider part of the inlet opening being at the head of the cylinder; and a nozzle E projecting from the other side of said jacket over the exhaust nozzle, and through which said exhaust nozzle discharges, substantially as shown and described.

657,472. Relief Valve for Locomotives, *S. M. Vauclain, Philadelphia, Pa.—Filed June 30th*, 1900.

Claim.—The combination of the cylinders of a compound engine, a hollow valve controlling the flow of

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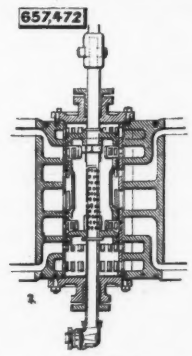

steam to and from the said cylinders, a hollow stem communicating with the passage in the valve, and a relief valve in this tubular stem closing against steam pressure substantially as described.

657,537. Apparatus for Feeding Comminuted Fuel to Furnaces, &c., *J. F. Hay, Erie, Pa.—Filed December 27th*, 1899.

Claim.—In an apparatus for feeding comminuted fuel, the combination of a receiver, having a discharge opening to which the fuel is delivered by gravity, a

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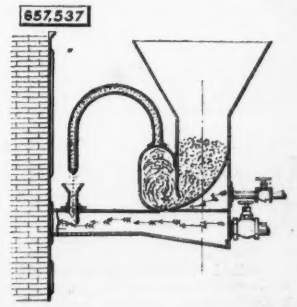


retarding surface below said opening for checking the discharge by gravity, and an air blast mechanism arranged to direct the blast from beneath the discharge opening upon the fuel lodged upon said retaining surface, and to feed the fuel therefrom.

GAS AND OIL ENGINES AT THE PARIS EXHIBITION.

No. IV.

Among makers other than French and English represented at the Paris Exhibition, the most remarkable oil engines shown were the Bánki and the Diesel. The former, made by the firm of Ganz and Co., of Buda-Pesth, is an engine of great promise, which has already achieved considerable success abroad. Here again we trace the application of a principle which engineers have long endeavoured to put into successful practice in a gas engine cycle—that of injecting water into the cylinder. The experiment was made as long ago as in the Hugon engine in 1861, but hitherto it has not proved economical. Scientific men have even doubted whether the admission of water has not, on the contrary, an injurious effect on the efficiency of the engine. Herr Professor Bánki has made an exhaustive study of the whole subject of combustion in internally-fired engines. As a result he has produced a motor in which the strikingly low consumption of oil already obtained justifies the belief that water, if admitted in proper quantities, at the right time, and in the right manner, may greatly add to the economical working of these engines.

The principle on which the Bánki motor is constructed, and the reason assigned for its economy, is the well-known fact that the more highly the gaseous charge in an engine cylinder is compressed the better, within certain limits, the engine will work. To compress the charge before ignition as much as possible is now known to be the chief factor in increasing the heat efficiency of the motor. But this high compression brings with it the drawback that, in spite of every precaution, premature ignitions often occur. Even if these can be avoided, the highly-compressed gas, especially if it be composed of imflammable oil or benzine vapour, explodes with the force of a blasting charge, and shakes the whole engine. Both Bánki and Diesel endeavour in different ways to solve this difficulty. Diesel admits and compresses the air separately, and only injects the oil into it at the end of the compression stroke, when ignition takes place and the pressure rises. Bánki adheres more closely in his arrangement to the ordinary four-cycle type.

In the Bánki motor the air is admitted at the top of the cylinder through an automatic valve. The oil runs by gravity from a receiver above, the very small quantity required per stroke being carefully regulated by a screw and a float. The admission valve is opened by the partial vacuum in the cylinder, and closed by a spring. A small injector is placed in the suction passage to the cylinder, which sends into it at the same time a jet of water, the quantity being determined by a screw and a float. The water and the oil are thus drawn in, together with a current of air, which converts both of them into spray, and carries them through the admission valve into the cylinder. The quantity of water is only just sufficient to moisten the air, and so to cool part of the cylinder as it enters. According to Bánki, the error formerly made was that enough water was admitted to the cylinder to form an appreciable amount of steam by its evaporation, and thus to increase the volume of the charge. In his motor he carefully regulates the quantity injected per stroke, which is very minute. As the water acts by cooling the charge, it is possible so greatly to reduce the compression space that the piston has a very small clearance between it and the cylinder cover, the passage leading to the valves for admission and exhaust practically forming the clearance volume. The water injections may be either before or after the benzine is introduced, and the air saturated first either with benzine or with water. In either case premature explosions are avoided, and the engine runs very quietly, in spite of the very high compressions used.

In other respects the Bánki is of the usual four-cycle type. It has hitherto been made vertical only, with two valves, the automatic valve already described, and the exhaust valve, the rod of which is driven from a small cam shaft parallel to the crank shaft. As usual with this type of construction, the inertia governor acts upon the exhaust valve, and holds it open if the normal speed is exceeded. To ensure that the automatic admission valve shall not rise, it is connected to the exhaust valve by a spring, which holds it firmly closed till the speed is reduced. No charge can thus enter. Ignition is effected without a timing valve, by a tube heated by an external benzine flame, the vaporiser being kept hot by the heat of the explosions only.

This system of water injections is one reason for the high efficiency and economy obtained. A trial was made by Professer Meyer in 1899 at Buda-Pesth, on a 20 horse-power engine, having a cylinder diameter of 10in. and 15·7in. stroke. The compression space, which was gauged by filling it with water, was a little more than one-tenth the total volume described by the piston, and a compression of 16½ atmospheres, as shown by the indicator diagrams, was attained. Nevertheless the engine ran quietly. To prove that its regular working mainly depended on the injection of a proper quantity of water, the amount was reduced; the shocks, it appears, were then very violent, while when the supply was wholly cut off the engine stopped altogether. It ran at about 211 revolutions per minute, and gave 25 horse-power on the brake. The oil used was benzine of 0·70 specific gravity, and having a lower heating value—water uncondensed—as determined in a Junker's calorimeter, of 18,522 B.T.U. per pound. The consumption during the trial, excluding the oil for the lamp, was 0·53 lb. per brake horse-power hour, and about five times as much water as benzine was used. The heat lost to the cooling jacket was 22·4 per cent. of the total heat supplied; heat efficiency per brake horse-power, 25·5 per cent. The consumption increased very slowly as the load diminished. Professor Meyer gives the consumption of benzine per brake horse-power hour, excluding that for the lamp, as follows:—At full load, 0·55 lb.; at half load, 0·65 lb.; at quarter load, 0·89 lb. The latter figure is of importance in engines when required to run with light loads. The quantities of water in these different experiments diminished with the load, the walls being cooler with many miss-fires. Professor Meyer attributes the low consumption with light loads to the smaller amount of water injected, the value of the high compression being thus more clearly defined.

A second set of independent tests was also made on the same engine by Professor Jonas. The oil used was of 0·73 specific gravity and 18,324 B.T.U. per lb. heating value (lower). The speed was the same as before. The engine gave 26·4 brake horse-power, the consumption, excluding the oil, for the lamp was 0·48 lb. per brake horse-power hour, heat efficiency taking the brake horse-power 28 per cent. The quantity of water injected was slightly less than before, heat lost to the cooling jacket 21·7 per cent.

The vertical 75 horse-power Bánki oil engine shown at Vincennes is considerably larger than the one on which these experiments were made. It has a cylinder diameter of 15·8in. and 23in. stroke, carries one fly-wheel and one balanced through crank. As far as the writer could judge, it seems well and strongly constructed, but the motor arrived very late, and was not at work even in July. There was also a 12 brake horse-power vertical engine at the Champ de Mars, with two fly-wheels, of the same type as the one already described, and a portable 3 brake horse-power engine; neither of these were working. The larger has water injections and tube ignition. The Bánki is the only oil engine shown in the Hungarian Section.

The Diesel, an engine which marks a new departure in internal combustion motors, was shown by the Maschinen Fabrik Augsburg, the most important and largest mechanical engineering firm in South Germany. The engine has been several times described in The Engineer, and we need merely mention here that the usual Otto cycle, giving one motor stroke in four, is followed, but with one or two important variations. During the first admission stroke the piston draws in and compresses air, which is delivered by a special air pump, and again compressed during the following stroke to a pressure of about 75 atmospheres, or nearly 800 lb. per square inch. Its temperature being thus greatly raised, a very small quantity of oil is injected into this highly heated and compressed air at the end of the stroke, and instantly pulverised, vaporised, and ignited by the high temperature of the air. No ignition tube or electric spark is required. The explosion drives out the piston in the usual way, giving a motor stroke, and the products escape during the fourth stroke. The three principles which Herr Diesel claims to have embodied in his engine are: Production of the highest temperature of the cycle, not by the combustion of the charge, but prior to it, solely by mechanical compression of the air; gradual introduction of the combustible into the air in such a way that the temperature does not rise, and the heat generated is at once converted into work on the piston; and lastly, admission of a much larger quantity of air than is required for combustion—usually about double. This excess of air takes up some of the heat generated.

The exceedingly economical results obtained with this engine have already been described in The Engineer—October 16th, 1897, and November 5th, 1898. An interesting paper on the subject was personally read by Herr Diesel at the Congrès de Mécanique in July last, which the writer had the pleasure of hearing. Of the Diesel oil engines exhibited at Vincennes, only one was shown by the German firm, and worked regularly and well. Many members of the Congress, including the writer, had the opportunity of inspecting it, and indicator diagrams were taken in their presence. It was a 60 horse-power vertical two-cylinder motor, each cylinder having a diameter of 13·7in. and 18in. stroke, speed 180 revolutions per minute. The engine drove a dynamo direct, and the exhaust into the air was quite invisible. The faint white smoke which is usually seen issuing from the discharge pipe of an oil engine was absent, and this showed good and complete combustion. To test the consumption of this engine at the Exhibition was not found practicable, but trials were made at Augsburg in December, 1899, upon another engine of the newest type.

This oil motor was of 30 horse-power nominal, with 11·8in. cylinder diameter, and 18in. stroke, speed about 180 revolutions per minute. Twelve tests were made with raw Russian naphtha, and twelve with Roumanian petroleum; the heating value of the latter (lower) was 18,000 B.T.U. per pound. With this oil the maximum power developed was 57½ horse-power, the minimum 17 horse-power running empty, and the most economical load was found to be 33 brake horse-power. At this power the consumption of oil was 0·46 lb. per brake horse-power hour, while several other tests gave a consumption below ½ lb. oil. When the engine developed only 10 horse-power on the brake, the consumption increased to 0·70 lb. per brake horse-power hour. At a load of 33 brake horse-power the thermal efficiency of this relatively small engine was 30·7 per cent. per brake horse-power, in other words about 31 per cent. of the total heat supplied to the engine was converted into actual work on the brake. This is the best figure of merit to compare the efficiency of all heat engines. In well-made and economical steam engines, developing from 1000 to 1500 horse-power, only about 15 per cent. to 16 per cent. is transformed into energy, or about half as much. With such high compression in the Diesel engine some of this power is required to compress the air up to 800 lb. per square inch, and the mechanical efficiency is naturally low, being about 70 per cent., the engine thus takes 30 per cent. of the power developed to drive itself and the air pump.

This high thermal efficiency shows that the best results in internal combustion engines are obtained when the curve of combustion most closely approximates to the isothermal, and also that, as insisted on by other writers as well as Herr Diesel, combustion is most perfect when the combustible is introduced into air already heated. It is the high temperature of the air, and the small and carefully proportioned quantity of oil injected into it, which ensure the perfect mixing and combustion of the charge. The large amount of air present in excess also contributes to this result, because each particle of oil finds a sufficient quantity of oxygen to burn it. If the air and oil be badly mixed, or allowed to get too cool, poor and smoky combustion will be produced. The exhaust should be practically invisible and colourless. In this engine no water is injected into the cylinder.

Herr Diesel carried out experiments on the same engine with lighting gas, when the consumption was 16·6 cubic feet of gas per brake horse-power hour; thermal efficiency per brake horse-power, 26·5 per cent.; mechanical efficiency, 75 per cent. The air was compressed up to 560 lb. per square inch. Tests were also made with generator gas, the results of which were equally good, and finally with powdered coal. These last were not so favourable, and considerable difficulty was experienced in dealing with this solid combustible. It was found advisable not to introduce the powdered coal into the highly-compressed and heated air at the end, but at the beginning of the compression stroke, and to compress the mixture, and to ensure ignition, a very minute quantity of oil had to be also injected. In spite of these precautions the internal surfaces of the cylinder became coated with coal powder. A separate type of engine seems to be required for this class of fuel, with a combustion chamber distinct from the motor cylinder. In the writer's opinion it is not worth while to incur the trouble and expense involved in preparing, crushing, and sieving the powdered fuel, when so excellent, pure, and fairly cheap a combustible as oil, which may be had ready prepared, is available. Herr Diesel proposes further to attack the problem of the two-cycle type, and to construct a 200 horse-power vertical, and a 12 horse-power horizontal two-cycle motor on his system.

Only two other German firms exhibited at Paris. MM. Koerting, of Hanover, whose engines have been popular for so many years in Germany, showed an 8 brake horse-power motor at Vincennes, driven with alcohol spirit. They have also at the Champ de Mars a 30 horse-power gas engine of their usual good type of construction, coupled direct to a dynamo, and running at 170 revolutions per minute. In both these engines the charge is electrically fired, and they are governed by graduated admission of the mixture, with no miss-fires. MM. Koerting had originally intended to show a large 500 horse-power engine, built on a new system, with one cylinder, working two-cycle, like a steam engine, and driven with power, high furnace, or coke-oven gases. As none of these gases were available at the Champ de Mars, and the engine was not designed for work with lighting gas, the project was abandoned.

MM. Grob, of Leipzig, who have long constructed the well-known Grob-Capitaine engines, exhibited four small oil motors at Vincennes. They have now in hand, it appears, gas engines to drive dynamos with an aggregate of more than 8000 horse-power.

The important Belgian exhibit of the large Simplex engine from the Seraing Works, driven with blast furnace gases, has already been described in the French Section. For smaller powers, up to 100 horse-power, this engine is made by M. Ch. Beer, of Jemeppe-sur-Meuse, who employs 250 men in its construction. He showed a 40 brake horse-power engine with a speed of about 220 revolutions per minute, driving a dynamo. As in all the Simplex engines, ignition is by electricity, and there is one through crank and two fly wheels. The diameter of the cylinder is 11·8in. and 17·7in. stroke. Another Belgian firm, having a large and important exhibit at Paris, is the Société Fétu Défize, of Liège, who make oil and gas engines of the ordinary Otto type. The charge is fired electrically, or by tube, as desired. Two stationary oil engines, of 10 horse-power and 6 horse-power, and a 2 horse-power gas engine were shown, together with an interesting series of small locomotive engines, to be worked with benzine, and run on a 20in. railway gauge. These small locomotives, which are well made and seem to be used in Belgium in mines and collieries, under and above ground, are constructed in three sizes, viz., 6, 8, and 12 brake horse-power. The weight of an 8 horse-power locomotive is 3½ tons. The rotary motion of the engine does not vary; the change of direction on the rails is effected by means of gearing. An oil locomotive was also shown by another Liège firm. These little engines should have a good future before them.

Among Swiss houses exhibiting at Paris we noted only one of any importance, MM. Martini, of Frauenfeld, who were among the very earliest makers of gas engines, and whose motors, although completely re-modelled, are still in demand. Their well-constructed engines driven with gas, oil, or petroleum essence, are vertical or horizontal, of the ordinary Otto type, chiefly for small powers, but oil essence is generally preferred as the motive force. They showed a 15 horse-power gas engine and two stationary oil motors of 3 and 18 brake horse-power. There were also two ingenious little oil locomotives for running on narrow-gauge railways, similar to those already spoken of, with motors driven with oil essence, and developing 4 and 5 horse-power respectively.

Lastly, we must mention a Russian, a Polish, and a Swedish firm. Bromley Bros., of Moscow, showed two vertical oil engines of the usual four-cycle type, in both of which tube ignition is used to fire the charge. The first, of 4 horse-power, has a single cylinder with a diameter of 7·1in. and 10in. stroke. The larger 8 brake horse-power motor has two cylinders, each having the same diameter and stroke as the smaller engine. The speed in both is 240 revolutions per minute. Machtchinski, of Warsaw, sent a small 2 horse-power oil engine of the ordinary construction, not working. Bolinders, of Stockholm, exhibited two four-cycle oil engines, stationary and portable, both developing 6 horse-power, with tube ignition, and started by means of air previously compressed in a separate receiver.

This completes our remarks on the leading gas and oil

engines shown at the Paris Exhibition. It was on the whole a decidedly interesting collection, with many new features, and well "up to date." The chief real novelties were German and Austrian.

LITERATURE.

Pumping Machinery. By HENRY DAVEY. With frontispiece, five plates, and over 250 illustrations. C. Griffin and Co. 1900.

FOR very many years one has persistently heard the inquiry, "Do you know of any really good book about pumps?" and the answer has been monotonously the same, "No; I wish I did. Do you?" There have been collections of advertising sheets, published within leather and pasteboard covers, in more or less abundance; there have been disquisitions without end upon that eternally uninteresting subject, "The flow of water over notches and weirs," the object of whose hundreds of pages appears to concentrate chiefly upon the determination whether the 1·57th or the 1·578rd power of the depth gives a less extravagantly errant value to the "constant" of a more or less foolish algebraic expression; and the "common pump" has afforded a basis of amusement to the frivolous race of hack authors who will write you elementary science manuals for "technical" schools on any branch of "technical science" you may prefer at so many shillings per yard. But, confining our survey within our unlearned ken of the Anglo-Saxon dialects, we do not recall the publication before this year of any book upon pumping that really deserves both the titles "technical" and "scientific." It must therefore have rejoiced many a heart interested in the progress of technical literature to hear that Messrs. C. Griffin had persuaded the one English engineer who probably knows more about pumping machinery than any other, to supply to them a volume recording the results of his long experience and study of the subject. The book now under review is a condensed *résumé* of what has been learnt in a long life of energetic work in designing and erecting pumping plants over a very wide area by an engineer who is nothing if he is not practical, and who at the same time has always held science in high respect, and has always been enthusiastic in his efforts to aid the progress of science in his particular branch of engineering.

The book is profusely illustrated. A considerable proportion of these drawings are general arrangements, without detail, to explain various methods of design and of working to suit the great variety of conditions under which pumping work has to be carried out. As many constructive details of pumping machinery are common to machines in general, it seems to us wise to devote much of the illustration to such general arrangement. Such details as distinctively belong to pumping and not to other kinds of plant are, however, amply illustrated. In a few cases we have noticed that these latter drawings are technically imperfect in the omission of some subordinate, but still essential, part. Regarding the commoner details, also, we find that the author condescends very little to textual explanation of the relative advantages of different forms, or to the proper methods of designing them. For example, there are twenty-seven different forms of pump valve shown on pages 58 to 62, but forty or fifty lines of text suffices to cover the whole subject of pump valves. Of course, other occasional references to this subject may be found throughout the book. But seeing that the efficiency of pumps depends probably more upon the valves than upon any other single feature, we confess we would have liked to have found an ampler treatment given to them in so important a book. Nearly all these twenty-seven valve illustrations show tapered seatings, but in a later chapter Mr. Davey strongly condemns tapered seatings for all large pumps. We may also say that we think that the illustrations hardly do full justice to certain kinds of pumping plant. For example, that of a Pulsometer on page 148 is not quite up to date; and although "duplex valve gear" is mentioned in a few lines at one place, we can find no reference to the Worthington pumping engines, except by a diagram of the hydraulic ram compensating device. Mr. Davey explains that "the device of making the working of one engine dependent on that of the other is old. Cornish engines in waterworks have been made to work alternately, when two engines were pumping into the same main, by coupling the valve gears of the engines by suitable connections, and as the steam stroke is quicker than the water stroke, one water stroke commenced before the other was completed." The fact that something like the modern duplex valve gear was used long ago is hardly a good enough reason for almost entire omission of description of so important a modern style of pumping plant.

Mr. Davey's first chapter is devoted to the "early history of pumping engines," and we do not think that any so terse or so interesting a history of the rise of this branch of engineering has been written before. It grasps well, and dwells upon, the essential points that are or were fecund in influence upon future development, and marshals the gradual progress towards higher efficiency very clearly before the mind's eye. In this history some interesting subsidiary points come out. Thus Mr. Davey tells us that we should give up believing in the existence of "the boy named Humphrey Potter," who attached a "scoggan," and thereby at one and the same time introduced automatic valve gear and gained time to play marbles with another boy, and bids us believe in place of that boy in a "buoy enclosed in a pipe attached to the cylinder." One cannot play marbles inside a pipe attached to a cylinder. Again, it is interesting to know that expansion by compounding the engines was introduced by Hornblower between 1776 to 1781, and only failed because there was then no steam pressure high enough to make compounding of any use. In reading the history of pumping it is very important to remember that in the earliest days the "duty" was calculated upon a consumption of 84 lb. of coal; that later and up to 1856 it was reckoned upon 94 lb. coal, and that since 1856 it has corresponded to 112 lb. coal consumption. Thus to make the early figures comparable with modern ones, they have to be multiplied by 1¼. Already in 1834 the duty had been raised to about 60 millions on 94 lb. coals, or 72 millions per cwt., and it is now in the best modern engines considerably less than twice this. Mr. Davey tells us that the improvement has been nearly wholly due to increase of steam pressure.

The method of measuring pumping engine efficiency by "duty" of so many million foot-pounds of work done per cwt. of coal burnt, is a more direct, and therefore a more rational method than the more modern "pounds coal per horse-power hour;" because the phrase "per horse-power hour" really contains no reference whatever to TIME or to RATE of combustion or RATE of doing work. Horse-power is so much work per hour, and in "coal per hour per work per hour," the two "per hours" cancel out. One pound of coal per horse-power hour means simply 1 lb. coal per 1,980,000 (or two millions less 1 per cent.) foot-pounds work, or 112 lb. coal per 222 (exactly 221¾) millions foot-pounds work. Thus a duty of, say, 113 millions per cwt. coal means the same thing as $\frac{222}{113} = 1{\cdot}96$ lb. coal per pump horse-power hour. On page 93 Mr. Davey gives a useful table of such equivalents for duties ranging from 40 to 150 millions, along with their multiples by 6, 8, and 10, showing the corresponding steam consumptions at evaporative efficiencies of 6, 8, and 10 lb. of steam per 1 lb. of coal, and also with these latter increased in the ratio 10/8 for an assumed ratio of 80 per cent. of pump to cylinder indicated horse-power. This table would have been still more useful in the form of a diagram of seven oblique straight lines running across squared paper.

The second and thirteenth chapters are upon the efficiency of pumping engines generally; and here Mr. Davey follows closely the prescriptions of the recent I.C.E. Committee upon Steam Engine Efficiency, using the three phrases, "thermal efficiency," "efficiency ratio," and "economy," in the senses recommended by that Committee, in conjunction with the "Rankine cycle," as the "ideal perfect steam engine." Tables are given to facilitate this method of computation, but these do not include a table covering the use of superheated steam. Here we think too much space is devoted to methods of minute arithmetic calculation, and too little to the practical methods of reducing the various losses in the engine. Thus only half a page is given to the subject of superheating, and only six lines to leakage past valves, pistons and glands, although loss due to leakage is a really very serious item in the majority of engines at work. A great deal of attention, however, is given to various means of utilising the exhaust heat in feed-water heating. One of these methods, introduced, as we understand, by the author, is the passing the feed-water under the heating influence of the equilibrium steam in Cornish engines. It is heated in two heaters in series, first by the exhaust and then by the equilibrium steam. This is a very ingenious method, and the results upon the economy seem to be extremely satisfactory. The author thinks that the best probable future results will be obtained by using about 260 lb. per square inch boiler steam, throttling down to 215 initial pressure in the cylinder and using full boiler pressure steam in jackets and in re-heaters between high and low-pressure cylinders. This is practically the Schmidt system, except that Mr. Davey prescribes special limits of pressure, and doubts the use of initial superheating. He says that "the superheating is then done in the engine itself and is not wasted in radiation from the steam pipe;" but he does not say why less waste by radiation from the steam-pipe should be expected from initially-saturated than from initially-superheated steam.

As regards re-heating, or superheating, steam at any point of its passage through the engine by means of steam of higher temperature, some engineers seem to forget that all the heat gained by the working steam in such re-heaters or superheaters is lost by other steam at higher temperature. A large portion of the "availability" of all the heat so passed is lost in the process; if retained in the steam of higher temperature and passed through the engine, that heat would yield a larger return in mechanical work done. The lowering of temperature by any conductive process is mere waste of heat so far as work done in the steam engine is concerned. Re-heating to the point of dryness in the intermediate receivers is desirable, not for the sake of re-heating, but for the sake of re-drying; but to do this by means of steam which has been generated at high temperature by a somewhat costly process is not the best means of accomplishing the object.

The author admires the Cornish equilibrium steam cycle in compound pumping engines, and he shows reasons why it is convenient for this special class of work viz., pumping. But he seems nowhere to discuss the possible loss of steam efficiency resulting from this cycle in the great pressure drop between the successive working strokes in the two cylinders. This drop is most in evidence in his diagram, Fig. 61, page 70, where it is from level G to level A. The working results of this diagram are correctly reproduced in the transformed diagram, Fig. 62; but the author does not call attention to the almost evident fact that the area of indicator diagram corresponds to a ratio of expansion little more than that carried out in the high-pressure cylinder, so that the second cylinder seems to have added little to the working capacity of the engine. This appears to be wholly due to the extremely large non-effective intermediate equilibrium area in the diagram 61. Otherwise stated, it is due to the drop of pressure from G to A in that diagram. On page 39, Fig. 7, the author seems to think this drop inevitable, whereas some of it can be prevented by proper setting of the low-pressure cylinder valves.

Chapter III. is devoted to constructive details of pumps, and, as already hinted, it is too brief to harmonise with our idea of the relative importance of pump and engine. The book as a whole is much more one on steam engines than on pumps, and increase of duty due to better boilers and better pumps is thrown too much in the background for true perspective. The dynamics of pump-valve opening and closing, and the consequent loss of head past valves and slip of water, are not dealt with. One reference is, indeed, made to negative slip; but the dynamic effects of valve weight, of valve mass and closing springs, of ratio of valve perimeter to area, of eddies below and above valves, are either overlooked or referred to only casually in connection with other matters. The important subject of acceleration in the suction at the beginning of the stroke is not referred to, although the well-known value of the "pause" before the beginning of each stroke is frequently mentioned, without, however, any explanation of its dynamic utility. Displacement diagrams are given for pairs of single-acting and double-acting pumps, with cranks at 90 deg., and for single and double-acting three-throw pumps; but the dynamic problem of the action of air vessels is nowhere tackled. On the other hand, the use of mass and generation of kinetic energy in it in order to render high ratios of expansion usable in long-stroke pumping engines where the resistance is constant throughout 80 to 90 per cent. of the stroke, is very fully and excellently discussed and illustrated, as are also the Worthington and the Davey mechanisms for reducing the pump resistance towards the end of the lifting stroke.

Chapter X. deals with engine valve gears. It is naturally a meagre account of this rich subject, which is not at all special to pumping plant, and requires a volume to itself to be properly dealt with. Those valve gears that are special to pumping engines are dealt with; the old Cornish and the Worthington very sparely, and the Davey Differential with greater completeness.

Chapters V. to IX., and XI. and XII. cover general and special descriptions of Cornish and other types of pumping plant, pit work, shaft sinking, hydraulic power transmission, water-pressure engines, and waterworks engines. These form naturally the best and most important part of the work. The author's great experience in arranging large pumping plants, and his wide knowledge of what other engineers have done in this sphere, have enabled him to gather together here in admirable terse form a vast amount of extremely interesting and useful information. In this domain, which occupies the greater bulk of the book, Mr. Davey's work will be accepted as the standard English authority for many years to come. It is thoroughly practical, and applies to a large range of very various conditions, geological and mechanical. Practically all the general arrangements that have been used up to the most recent dates for mines, waterworks, and drainage, except the Worthington plants, are here illustrated by one or more examples. In each drawing a good method of indicating the scale, namely, that of marking on, in very large bold figures, one important leading dimension, is adopted. In many cases complete details of sizes and working results on tests are tabulated. Sometimes details of tests are given at somewhat tedious length, as in the extract, four pages long, from the "Transactions" of the Institution of Civil Engineers, giving M. Eugéne Biver's report upon plant erected by the author at Marseilles. A valuable feature of many of the descriptions is that they include statements of working costs and costs of erection. Of course these must always be considered in connection with the local conditions; but when so considered, and it being remembered that such conditions alter the figures greatly, such information cannot fail to be instructive. Mr. Davey generally reduces the total cost of construction to so much per engine indicated horse-power, and so much per pump horse-power. The 300 horse-power hydraulic-power pumping plant at Marseilles, including shaft work, buildings, and tanks, cost £29 per indicated horse-power, and £50 per pump horse-power. The author's ingenious "steam regulator," used in place of a dead weight accumulator to steady the pressure in hydraulic transmission mains, is fully described. To counteract the pressure variations due to the intermittency of the action of the supply pump, this device seems admirable, because at this end of the transmission the steam cylinder of the regulator may be made part of the intermediate receiver of a compound engine, and thus no material loss from increased steam condensation arises from the use of the regulator. It is of no use, however, for mitigating variations of pressure arising at the other end through the intermittency of the flow throw the water power engines. Mr. Davey states that "in the ordinary application of hydraulic pumping in mines the efficiency of well-designed plant should be 60 per cent." He tells us that the loss is unaffected by the water pressure, so that, other things being unchanged, the efficiency is greater with heavier pressures; but we find nowhere any hint that the efficiency depends upon the water velocity or size of pipe, and also upon the length of the transmission, nor any explanation of the mode in which efficiency depends upon these things, nor any indication of how one should find the size of pipe that may be expected to give the best results. Curious omissions of this sort occur here and there throughout an otherwise very practical book. On pages 197 to 206 will be found illustrations and descriptions of the very ingenious and compact form of admission and eduction valve, devised by the author for water-power engines; and in the following pages a description of the extremely curious manner in which such an engine used for pumping was made to work with only one pipe to serve both for water supply and discharge, to and from the engine, and also for the pump delivery. This, of course, is only a curiosity in engineering, not an arrangement desirable except in very special circumstances; but it is a good illustration of how apparent adverse impossibilities may be overcome by mechanical ingenuity.

Chapter XIV. deals with scoop wheels and centrifugal pumps, concerning which not much information of a scientific character is available. The author mentions that "experiments are being made" with "combined,"

or, as they are variously termed, "compound" or "conjugated," centrifugal pumps, in which a number of pumps are mounted on one shaft, the water flowing through them in series, having its velocity reduced and its pressure raised between each pair of pumps.

On the Continent this construction has got beyond the experimental stage, these pumps being sold for forcing up to a head of 500ft. It is a question—one which we have not seen discussed—whether these pumps are rightly called centrifugal, or, otherwise put, whether they raise pressure by true centrifugal force in a rotating mass of water, or whether they simply impart high velocity, the kinetic energy of which is changed to static energy of high pressure after leaving the pumps in *évasée* eduction passages.

The compound system, as carried out now on the Continent, is said to depend wholly upon the latter action. We suspect that in the usual so-called centrifugal pumps there is a combination of the two actions. Do not the claims of rival constructors as to the superiority of one or other form of blade depend mostly upon their individual success in developing either the one or the other kind of action? One form of blade will favour the one; another form will be most suited for generating the other action.

Mr. Davey's final chapter is devoted to hydraulic rams, and the momentum effects in long water mains. In this chapter he also describes Taylor's, Davey's, Sommeiller's, and Pohl's hydraulic air compressors.

The "Target Book."—No. I.: France.

We are afraid that we cannot congratulate the Naval Intelligence Department upon its latest effort, the "Target Book." It has good points; the system to indicate what can be penetrated by such and such a gun is valuable (where correct), and the sign is convenient. Books issued solely for the use of naval officers should, however, aim at a certain amount of correctness. For such naval officers as may tend to pin faith on the work we would point out the following more important errors—we lack space for all. The Formidable (French) with her new rig is procurable from any Toulon photographer. The Admiralty photograph is three years out of date. Duperré has two masts, not three. Courbet, ditto. Dévastation ditto. The after guns of the Courbet are carried lower down, the stern having been cut away. There are a number of 4in. quick-firers on the upper deck—visible in photos procurable in Paris at sixpence each—which are ignored in the Admiralty's plan. There are four before the funnel, six abaft it. The gun in the bow is a 6·4in. quick-firer, not a 10in. Dévastation has no stern torpedo tube. Otherwise the information concerning the Courbet and the Dévastation is fairly correct. The statement that the Hoche is "probably altered in appearance" is also pretty correct. A photograph taken seven or eight years ago does not do good service for her now. She has at present two funnels abreast, and a foremast like the Redoubtable. The superstructure shown in the plan is gone. The turret bases are not modelled on the pyramids. The protective deck is curved, not flat. The conning tower is not at the base of the mast, but well before it. The Charles Martel carries her amidships barbettes well aft. Her 5·5in. guns are not as indicated on the plan. The St. Louis class have no shields to the 4in. guns, and these stand on big supports, not as indicated on the plan. Jémappes and Valmy have triple bottoms. The Dugueslin and Vauban have totally different funnels and rig. The Friedland has but two masts. Funeul is entirely out of date as given in the book. Requin, &c., ditto. An extra quick-firer is mounted amidships on the superstructure. The Bruix class have armoured hoists to the turrets like those of the Jauréguiberry, but without the funnel shape to them. The Guichen and Chateaurenault are not alike—their hulls are quite different. Guichen also has three masts, not two as shown. The Jéna plan is of questionable accuracy. The plan of the Desaix is that usually current, but a totally different one has been published in France. We doubt the accuracy of the armour as shown in the d'Entrecasteaux. Information that armour is "Compound or Creusot or Harvey" leaves something to be desired on the grounds of utility. The Carnot's armour is Creusot steel. It would have been convenient to have given the English equivalents for millimetres.

As this book is issued for our Navy's use—we believe we are correct in saying that it is something "confidential" designed to occupy the niche that Brassey's *Naval Annual* held afloat, when 200 copies were issued officially each year—we think that a little more trouble might be bestowed upon it. Only the first volume—France—is yet out. The majority of the errors to which we have drawn attention could have been avoided by a study of *Le Yacht* for the last year or so, or by a perusal of our "Dockyard Notes." Seeing that nothing but careful copying and a little mild piracy is required, we think the task is possible of accomplishment.

Stresses and Strains: Their Calculation and that of their Resistances. By Formulæ and Graphic Methods. By FREDERIC RICHARD FARROW, F.R.I.B.A. London: D. Foudrinier, *Builder* Office, Catherine-street, W.C.; also of Whittaker and Co., Paternoster-row, E.C. 1900.

THE present hand-book, which starts with the assumption of the very minimum of mathematical knowledge and skill on the part of the reader, is intended as an assistance to architectural students, more especially that class intending to become candidates for the examination of the Royal Institute of British Architects. It is stated that "for all ordinary cases it is not requisite that the student should have any more extensive knowledge of algebra" than that which will enable him to "perform with readiness" some very simple operations. When it is found that all these operations depend upon the algebraical axioms, that if the same quantity be added to, or subtracted from, and the same multiplier or divisor be applied to, both sides of an equation, its value is not altered, the standard of mathematics at the examinations does not appear to be very high.

There appears in Chapter III. to be a little confusion in the use of the terms stresses and strains, which seem sometimes to be employed synonymously. The definition of them and the distinction between them should have been more clearly and correctly indicated.

When treating of stanchions, columns, and posts, Gordon's well-known formula is employed, slightly modified, which is quite as good as any of numerous others, none of which agree in their separate calculations with more than approximate results. The examples in the "graphic method of calculation," although only on an elementary scale, are well selected and very clearly explained. We do not quite endorse the remarks respecting rolled iron and steel joists made on page 56. It is true that it is contended by the advocates of the solid web system, that the web does relieve the flanges of one-sixth of their usually allotted stresses, but English engineers do not proportion plate girders on this assumption. As a matter of fact, some American engineers will not allow the vertical rib of the angle irons joining the web and flanges of a plate girder to be taken into account in the calculation of the required sectional area of the flanges, which is running into the other extreme. The riveting in Fig. 32, termed "diagonal," is usually called zig-zag, to distinguish it from chain riveting.

It would have improved the diagrams illustrating the "reciprocal diagrams of forces" if the compressive stresses had been shown by thick lines and the tensile by thin lines, and some further explanation respecting the method of distinguishing them would have been acceptable. It may perhaps be here pointed out that the example in Fig. 59 does not belong, as stated, to the Whipple-Murphy type. It is the Howe truss, and is much used for composite structures. In this instance the vertical members of the web are in tension and the diagonals in compression, the whole structure constituting a through bridge, with the loading on the bottom boom. On the other hand, the Whipple-Murphy truss constitutes a deck bridge with the loading upon the upper boom, and the character of the trusses upon the members of the web is reversed. A brief chapter is given to arches and abutments, including only those on the rousoir principle, and another to retaining walls, and short rules are enunciated for the guidance of students which, in two subjects which are a frequent theme of discussion between the engineers of different countries, may err, but it may be fairly presumed on the side of safety. One feature of Mr. Farrow's volume, which will strongly recommend itself to all students, is that the numerous examples are all fully worked out in the body of the work, as are also those contained in the Appendix and taken from some of the examination papers.

SHORT NOTICES.

Waterworks Distribution: A Practical Guide to the Laying Out of Systems of Distributing Mains for the Supply of Water to Cities and Towns. By J. A. McPherson. London: B. T. Batsford. 1900. Price 6s. net.—This small book of some 150 pages is divided into five chapters. The first chapter deals with the general arrangement of supply to district of distribution; the second consists of notes upon the system of distribution; in the third, the details of the method of laying out distributing mains; the fourth, the pipes and fittings upon distributing systems; and the fifth deals with meters and the measurement of water, and regulating and recording apparatus. There are a number of explanatory diagrams and some hundred illustrations. Some of these are simply direct reproductions from freehand drawings, but in spite of this they are effective and explanatory. The book is well printed, and nicely got up, and will no doubt carry out the intentions of the author, *i.e.*, that it should be of service to "those interested in laying out systems of distributing mains, as well as to students and candidates for the municipal and county engineers' and other examinations."

The Lead Storage Battery: Its History, Theory, Construction, and Use. By Desmond G. Fitz-Gerald. Illustrated. London: Biggs and Co.—The subject matter of this book first of all appeared under the title of "Notes on Accumulator Construction" in the columns of the *Electrical Engineer*. It is not intended to be introductory nor quite elementary, nor is it meant for those who are altogether unfamiliar with any of the ordinary types of secondary batteries. It consists of some 380 pages, and is divided into 23 chapters. The whole subject of the storage battery is dealt with from every point of view, and the resulting book should certainly be found useful. Considerable space is allotted to the chemistry of pyroxylin, as the author considers it probable that this substance is likely, under certain conditions, to be largely used in accumulator construction, and that the peroxide element may ultimately be made with a manufactured compound of pyroxylin with lead in powder, or partly in the condition of oxide. The author, however, states that in his opinion the time has not yet arrived for this suggestion to be commercially carried into effect.

Manual of Electrical Undertakings, 1900-1901. Compiled under the direction of Emile Garcke, M.I.E.E., F.S.S. Vol. v. London: Donington House, Norfolk-street, W.C. 1900. Price 12s. 6d. net.—This useful book appears again, enlarged from 1036 to 1272 pages. In spite of this, however, the volume is less thick than its predecessors—a result brought about by employing thinner paper. This is a movement in the right direction, for last year's book certainly approached very nearly the limit of size and weight beyond which its value as a book of reference would be diminished. The extra number of pages in the present issue deals with 653 undertakings as compared with 536 in the preceding volume. The whole of the information has been brought up to date, and, in short, the whole volume is even more efficient than the four others which have gone before it.

The Royal Navy List Diary and Naval Hand-book for 1901. London: Witherby and Co. Price 3s. net.—The exact counterpart of the three volumes which have preceded it, saving that it has been brought well up to date, and that the diary is for 1901. The editors have striven as much as possible to keep the same subjects on the same pages on which they have appeared in former issues. This is an excellent feature which will be greatly appreciated. To naval men who already know the worth of this diary, the new edition wants no recommendation. It is useful not only to those in the service, but to those who are in any way interested in naval matters. The present volume is well up to the form of those which have gone before.

BOOKS RECEIVED.

What is Heat, and What is Electricity? By Frederick Hovenden. With diagrams. London: Chapman and Hall, Limited. 1900. Price 6s.

Pumps and Pumping Machinery. By Frederick Colyer. Part II. Second edition. Revised, enlarged, and partly re-written. London: E. and F. N. Spon, Limited. 1900. Price 28s.

A NEW RAILWAY BETWEEN GERMANY AND TRIESTE.

A FEW months ago the Austrian Government introduced in the Reichsrath a Bill to authorise the execution of various railway works, including the construction of a main-line connection so as to provide a second means of communication with Trieste, but in consequence of the internal political condition of the country the scheme for an alternative railway route has not yet received the approval of the Parliament. In the meantime it may be mentioned that for at least thirty years Austrian manufacturers and travellers from different parts have urged the necessity of establishing a second railway connection with the Austrian port. A glance at the railway map of the country will show that from the interior of Austria the only main line direct from Vienna to Trieste is the Southern Railway, whilst the other main line, which shortly before reaching Trieste effects a junction with the Southern Railway at Nabresina, passes over Italian territory for a considerable distance between Pontebba and Cormons in a circuitous course. That the roundabout route followed by the latter is not the only reason which deprives it of any claim to being a second direct line is shown by the fact that industrial Bohemia, the German hinterland, and the whole of Bavaria, are in need of a direct connection with Trieste. This will be understood when it is stated that travellers from Frankfort, Nuremberg, or Munich, who desire to reach Trieste, have actually to journey thither by the circuitous route of Vienna, and thence by the before-mentioned Southern Railway to their destination.

As the whole question has been under consideration for so many years, it is scarcely necessary to mention that various schemes have from time to time been suggested for establishing a second rail connection between Germany and Austria at Trieste. The most recent schemes are those of the Government and of Herr Buchelen, of Trieste. The latter proposed two routes: the Tauern Railway and the Karawanken line. The first scheme provides for the construction of a railway from the existing main line at Lend—south of Salzburg—through the High Tauern and Gastein to Sachsenburg, where a junction would be formed with the existing railway as far as Tarvis. Here the new railway would be resumed, and, avoiding Italian territory, it would proceed by way of a tunnel through the Predil Pass on to Goritz, where a junction would be effected with the railway leading through Nabresina to Trieste. The construction of the Tauern Railway according to this plan would shorten the distance to be travelled to Trieste by 40 kiloms. in the case of the west of lower Austria, by 63 kiloms. from Bohemia and North Germany, 78 kiloms. from Salzkammergut, 150 kiloms. from South and Central Germany, and by 208 kiloms. from Salzburg. It will be obvious that next to Salzburg, the principal advantage of this route would fall to Germany. This is the reason why many Austrians object to the plan, whilst others submit that as the railway would be nourished from the heart of Germany, this scheme would have the safest financial future. The second railway—the so-called Karawanken scheme—would commence at Glandorf on the Vienna-Bruck-Villach main line—Rudolfs Railway—and proceed to Klagenfurt. Here the line would follow one of two routes. It would either go in a westerly direction *viâ* Bach and Wochein to Goritz, and thence on to Trieste, or it would be built *viâ* Krainburg and Laak to Divacca on the Southern Railway leading into Trieste. In either case it would be necessary to construct a tunnel to convey the railway through the Karawanken mountain chain at the Loibl pass. The journey northwards from Trieste by the Karawanken route would be reduced by from 50 kiloms. to 80 kiloms., but opposition is even raised to this scheme. In the first place, objections have been made in Vienna, which neither desires the Tauern nor the Karawanken Railway, because the adoption of either scheme would divert from that city a large portion of the traffic from the north; and, secondly, by the Southern Railway Company, which entertains apprehensions of damaged interests by the construction of a competitive line. In the third place, the Hungarians are opposed to both schemes, as they contend that the carrying out of either would lead to the development of Trieste to the detriment of Fiume.

The Austrian Government has, however, not adopted in their entirety either of these two schemes in the Bill presented for the consideration of Parliament for the establishment of what is officially termed a second rail connection with Trieste, and which comprises a series of lines. These consist of the Tauern Railway, which would lead from Swarzach on the State line Bischofshofen-Zell *viâ* Gastein through the Moll Valley to Spittal on the Southern Railway system between Villach and Franzenfeste; the Barengraben lines from the Southern Railway stations at Villach and Klagenfurt to Assling on the Tarvis—Krainburg State section; the Wochein line from Assling to Goritz, and finally the continuation from Goritz to Trieste. The proposed Pyrhn Railway belongs to some extent to this series of lines. It would commence at Selzthal on the Enns, and pass through the Pyrhn Mountain to Steyerling, so as to form a connection with the railway leading from that locality to Wels and Linz. The total length of the railways forming the second connection with Trieste would be 329 kiloms., and as they would be difficult of construction owing to the mountainous character of the districts to be traversed, the capital expenditure is estimated at £14,000,000. The Government Bill calculated that the railways would be constructed gradually, and that all of them would be completed by the year 1907.

H.M.S. SPARTIATE.—On page 519 it was stated that during the trials of this vessel a hose had to be played on "the high-pressure cylinder." This should read on "the high-pressure cylinder cross head guides."

SOCIETY OF MODEL ENGINEERS—GLASGOW BRANCH.—A branch of this Society has been started in Glasgow, and already there are between twenty and thirty members. The head branch in London has some sixty members, but the promoters of the branch on the banks of the Clyde hope to have a larger membership than this, once things are fairly started. According to them, "model engineering is now no longer looked upon as mere play, but as a help to serious business."

GLASGOW UNIVERSITY ENGINEERING SOCIETY.—On Saturday, 24th inst., the members of the above Society visited the works of Alley and McLellan, Polmadie. The party, numbering about sixty, were met at the gate of the works by Mr. Judd, and conducted through the different departments, special attention being given to the test-house, where several interesting experiments were being carried out. The various specialities of the firm, valves, steering gear, air-compressors, and high-speed engines for electric lighting, were ably explained, and at the conclusion of the visit, on the motion of Mr. Bamford, a vote of thanks was cordially given to the firm, to which Mr. Judd suitably replied.

PRIME MOVERS AT THE PARIS EXHIBITION.

No. XIV.

AUSTRIAN SECTION.—ERSTE BRÜNNER MASCHINENFABRIK.

We have already mentioned several of the excellent exhibits coming from Austria. Not the least remarkable among these was the horizontal compound steam engine of the Erste Brünner Maschinenfabriks Gesellschaft. The works of this company started operation as long ago as 1836, and the jealousy with which they view their long-earned reputation for high-class work is reflected in the above name, adopted at a later date. It was in 1872, the year of the great Vienna Exhibition, that they became a limited company, and carefully distinguished themselves from the Brünner Company by the proud prefix "Erste." They have about 2000 employés, and make a speciality of steam engines, having in recent years aimed particularly at engines for dynamo driving. They have supplied engines for electric light and power, not only in Austria and Hungary, but also in Russia, Germany, Holland, Italy, South America, and the Transvaal. They are at present supplying boilers and engines for the City of Vienna Electrical Central Station, the first instalment of whose equipment consists in eight engines and dynamos, each of 8000 horse-power, and thirty-two water-tube boilers, with a total heating surface of 9600 square metres. Their engine at the Paris Exhibition drove a three-phase 2200-volts dynamo, built by Ganz and Co., of Buda Pesth, and generating 1200 kilowatts. The rotating field-magnet wheel of this machine being 21 tons in weight, and 4·1 m. in diameter, no other fly-wheel is needed. It is mounted on the middle of the crank shaft, the high and low-pressure cylinders being placed one on each side and the cranks overhanging the two main bearings. The engine is designed for slightly superheated steam of twelve atmospheres pressure and 125 revolutions per minute, and is provided with an injection condenser. With ten-fold expansion it develops about 1000 brake horse-power, and about 800 with fourteen-fold expansion. Under these conditions and a good vacuum, the steam consumption is stated to be 5·2 kilos. = 11½ lb. per horse-power hour.

The special features in the construction lie chiefly in the valves and valve gear, the governor, and the stuffing-boxes.

Fig. 1 is a plan of the whole engine, showing the high-pressure cylinder in longitudinal section. Fig. 2 gives the low-pressure cylinder, the crosshead and guides, and the air and feed pumps in vertical section. Figs. 3 and 4 are cross sections of the high-pressure and low-pressure cylinders, taken the first at the centre to show the stop valve, and the second at the end to show the admission and exhaust valves.

The cylinders are 525 and 950 mm. in diameter, with 900 stroke. Thus the normal piston speed is 225 m. =750ft. per minute, but the engine has also been run successfully at 135 revolutions, increasing the piston speed to 810ft. Quiet continuous running at this speed, with superheated steam at 175 lb. per square inch pressure, is a very considerable practical success, which cannot be obtained without very good workmanship or except as the result of skilful simplicity of design. These two qualities appear in an eminent degree in this engine.

The bed-plate frame for each side is of bayonette pattern, the front cylinder cover, the guides and the main bearing block being cast in one piece. There is a splash cover over the crank, and this is of cast iron in one with the frame, adding very considerably to the rigidity of the whole. The main shaft bearings are each 300 mm. in diameter by 600 length. These have 4-part brasses adjustable horizontally, and lined with white metal. The crank pins are 180 by 230 mm., and the crosshead pins 150 by 200 long. The guides are bored out to a diameter of 660, and each slipper surface is 360 mm wide by 600 long. The crosshead is of forged steel, with cast iron slippers, each of these having a separate screw adjustment. A bronze pin bearing is inserted in the crosshead. The piston-rods are 115 and 135 in diameter. These are both prolonged through the back covers, and are supported behind these in swivel bearings adjustable in level. Guard tubes enclose these piston-rod prolongations.

The two cranks are placed 120 deg. apart, the low-pressure crank leading, instead of the more common arrangements of 90 deg. or 180 deg. The reason given for this is that the masses balance each other better, and that, therefore, steadier running is obtained with this crank angle. This is surely a mistake. With proper

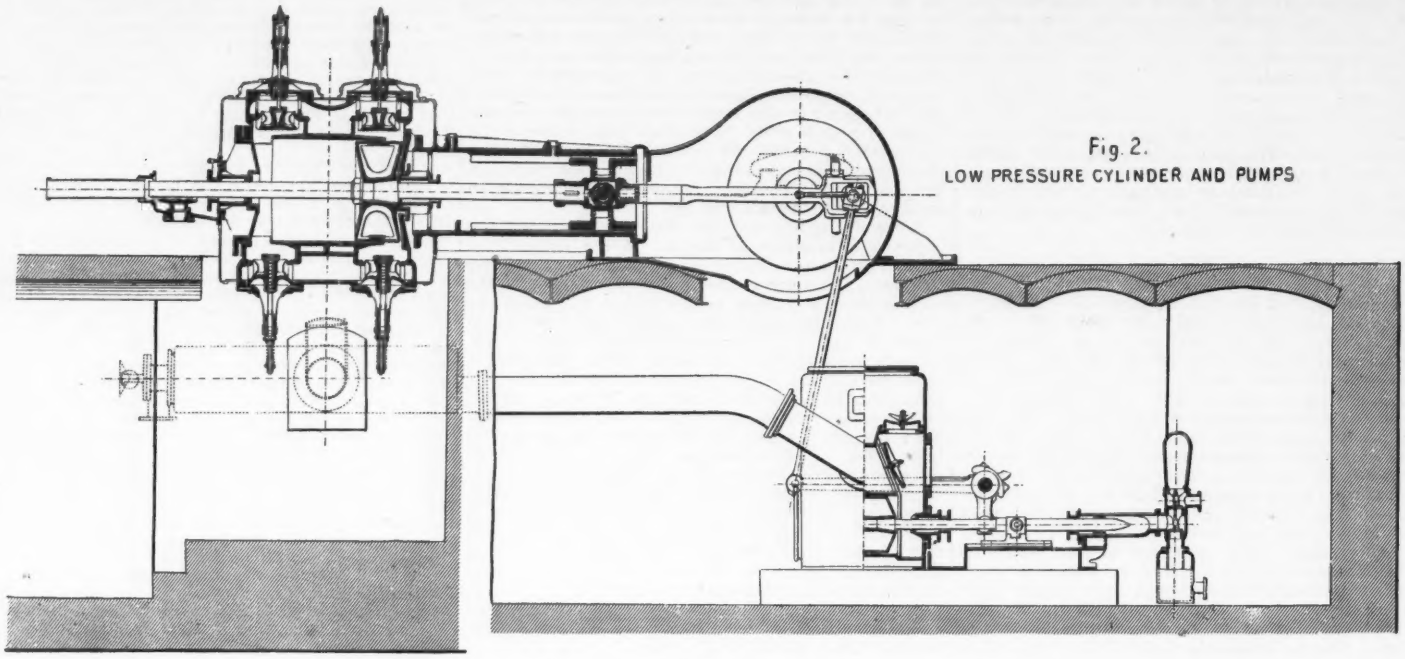


Fig. 2.
LOW PRESSURE CYLINDER AND PUMPS

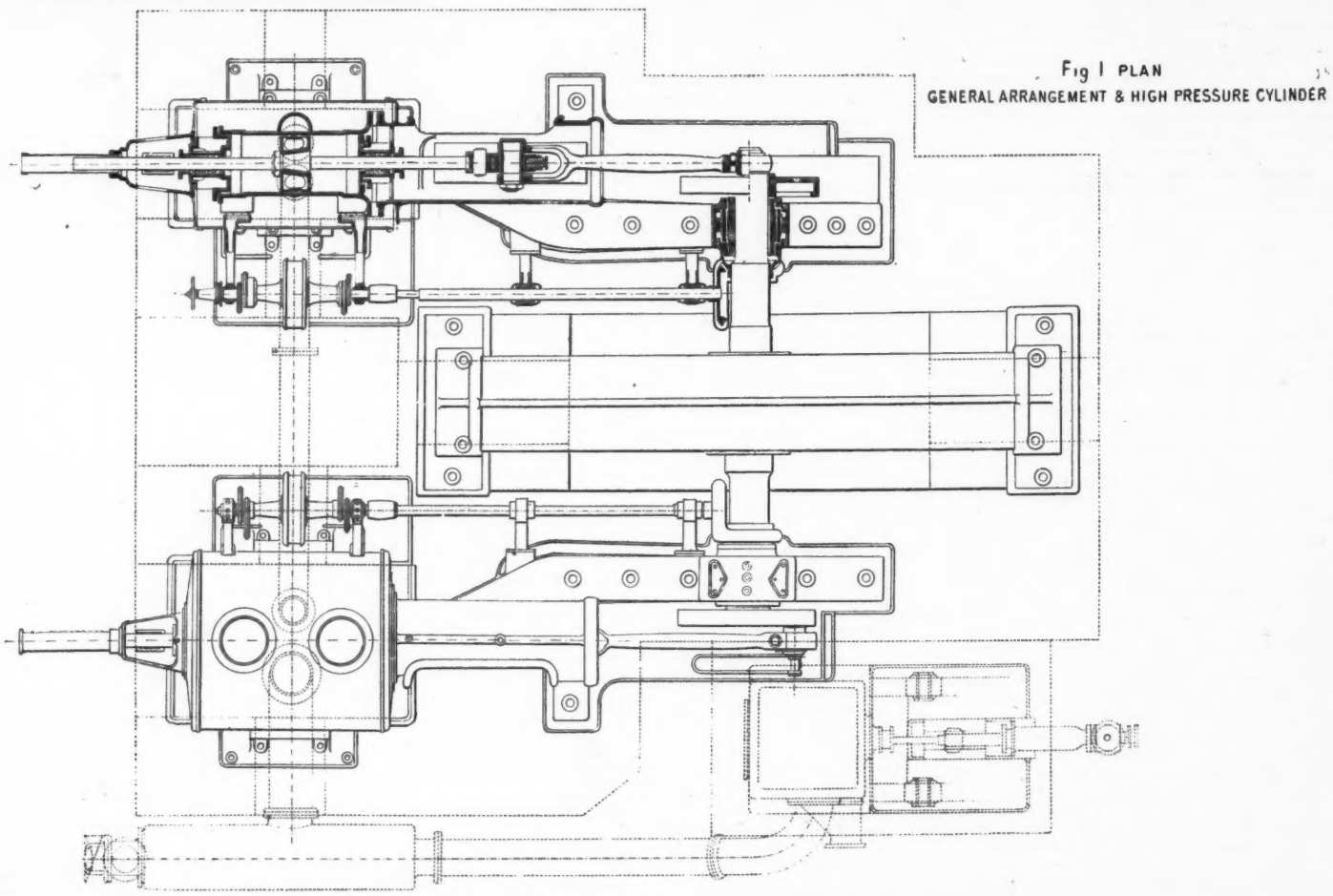


Fig 1 PLAN
GENERAL ARRANGEMENT & HIGH PRESSURE CYLINDER

HORIZONTAL COMPOUND STEAM ENGINE—ERSTE BRUNNER MASCHINENFABRIK GESELLSCHAFT

balance weights as good an acceleration balance can be obtained in the one case as in the other, although, of course, it will be admitted that without balance weights the want of balance is worse with 90 deg. than with 120 deg.

On the other hand, the variation of driving moment runs through a much greater range with 120 deg. than with 90 deg. A three-cylinder engine with three cranks at 120 deg. gives an extremely uniform turning moment; but the want of one out of the three cranks changes the moment diagram from great uniformity to great want of uniformity. The actual cranks used on this engine are discs with leaden counterbalance weights cast into them. These disc cranks are pushed on to the shaft ends by heavy hydraulic pressure. The cylinders rest on planed horizontal platforms supporting their weight, but permitting free horizontal expansion. Figs. 1 and 3 show that the high-pressure cylinder is not jacketed. Its valve chest, cast along with the cylinder, forms a channel running along one semi-circumference of the cylinder, and along its top in the form of a belt; and in the vertical part of this belt is placed the stop valve of the somewhat unusual pattern seen in Fig. 3. If wet steam were supplied to the engine, the plan of making it enter the valve chest by a rising vertical channel would be an excellent one; but as the engine is stated to be intended for use with superheated steam, it might have been better to keep this belt more detached from the cylinder, and thus give this latter a better chance of symmetrical expansion and contraction.

Two side shafts are driven by bevel gear from the crank shaft. That on the low-pressure side carries a small fly-wheel and four excentrics driving the four double-beat equilibrium lift valves. The cut-off of the admission valves can be regulated by hand. The valves and gear on this side are throughout of the same kind as on the high-pressure side, on which side, however, the place of the fly-wheel is taken by a shaft governor enclosed in a rotating case of exactly the same dimensions as the low-pressure fly-wheel. This symmetry of external form on the two sides adds to the neat and simple general appearance of the whole, but makes the arrangement a little puzzling and deceptive at first sight. The shaft governor controls directly the two excentrics which drive the high-pressure admission valves, altering both

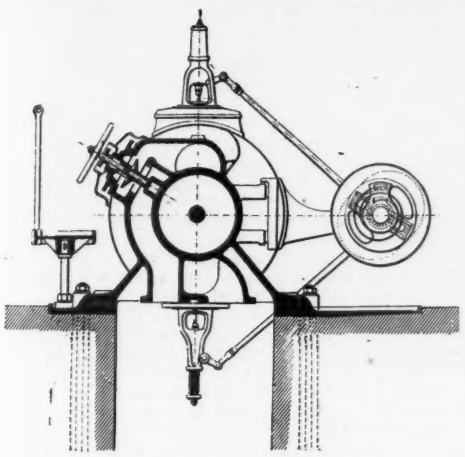


Fig. 3—BRUNNER H.P. CYLINDER

the throw and the angular advance as the speed changes. On the far end of this side shaft is mounted a hand wheel, by means of which one can slacken or tighten up the springs of the governor so as to alter the normal speed within a considerable range. This can be done while the engine is running. The similar end of the low-pressure side shaft drives a lubricating oil pump.

The sections—Figs. 3 and 4—show the drive of the valves. It is a direct positive gear without trip. The excentric rods oscillate cam levers pinned on fixed fulcra. These cam levers, which are shaped somewhat like a boot, the sole of which is the acting surface, lift the valve stems by hardened steel rollers pinned in the recesses slotted in the enlarged portions of these stems. These enlarged portions, which are of rectangular section, act as the guide surfaces. They are wholly buried in slotted guide boxes, whose upper parts contain the closing springs. Thus from outside none of the moving parts are visible except the excentric rods and the cam levers, which latter enter the guides boxes by narrow slots of width equal to the thickness of the lever. The effect of this is an extremely-pleasing external appearance of simplicity, which is unfortunately not made evident in the drawings which we publish. Kinematically the character of the rise and fall motion given to the valve depends chiefly upon the S shape given to the cam surface of the lifting lever; but the object of obtaining a quick lift and quick fall throughout most of the stroke, while the fall finishes at a very small velocity, is assisted by the proper proportioning of the three angles (1) between excentric rod and short arm of lever, (2) between the two arms of the lever, and (3) between the long arm of the lever and the valve stem. Otherwise stated, it may be said that the kinematic result depends greatly upon the exact location of the fixed fulcrum of the cam lever. It is stated by the makers that the gear eliminates all lateral horizontal pressure between the cam and the lifting roller, and this result is easily attainable from a geometrical point of view, although the drawings supplied to us hardly seem to substantiate fully the statement. This result would be obtained if the point of contact between cam and roller remained always on the vertical centre line of roller and valve stem; but a small deviation to right or left of this point of contact from the centre line would mean a large horizontal component of the lifting force, because of the small diameter of the roller. In action the gear certainly works with great quietness. We are informed that a vertical engine with this gear has been running several months at Brünn at 200 revolutions per minute.

The valve stems have no stuffing-boxes or glands in the ordinary sense. Each stem has cut upon its surface a large number of small ring grooves, and the portion so formed passes through a solid close but easy-fitting sleeve, at the centre of whose length is fashioned a recess leading to a discharge tube. The outer end of the ring-grooved part of the rod passes at each stroke into a closed oil box, into which oil is constantly supplied. The last one or two grooves on the stem thus get filled with oil at each stroke, and draw down this oil into the sleeve. A continuous slow circulation of oil is thus kept up from groove to groove down the sleeve to the discharge recess. This gives a perfectly steady and durable guidance to the rod, combined with steam-tightness, good lubrication, low temperature, and very little friction. The grooves are said to draw down the oil beyond the discharge recess into the inner half length of the sleeve. It would appear as if this inner half length would be better served if the oil were introduced at the inner instead of at the outer end of the sleeve. Special metallic packings are also used for the piston-rods at both ends of the cylinder. The pistons are cast hollow and made of great depth. Their packing consists of two cast iron rings, which depend upon their own elasticity for their outward spring.

The valves contain in their construction a most interesting novelty, the description of which suggests to the mind a Chinese ivory lathe puzzle. The valve itself, and its seat, are cast together in one piece and of the same metal. If one looks at the section of such a valve—see Fig. 4, with the valve lifted from its seat—one sees that the two may easily be cast in one piece by filling up with two rings of metal the lift-spaces between seat edges and valve faces. In the lathe, after all other parts have been finished, these two connecting ring parts are slit through, leaving the valve detached from the seat. This construction has two advantages. It ensures that the valve and seat are of the exact same quality of metal, so that they will expand and wear alike. This applies with special

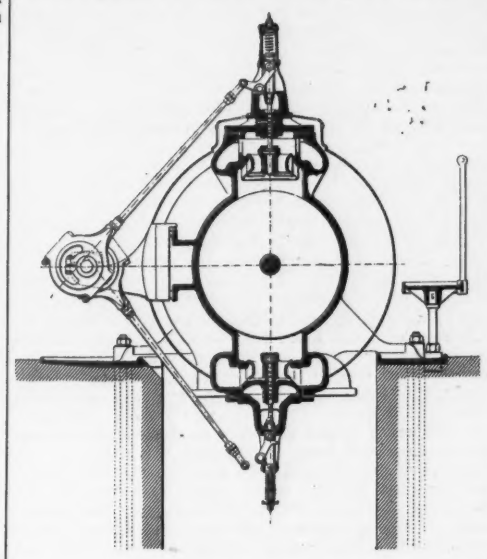


Fig. 4—BRUNNER L.P. CYLINDER

exactitude to the parts of the casting coming together as seat and valve faces. In the second place, it permits the two seats to be made, without any difficulty, of exactly the same diameter, thus ensuring exact equilibrium, except in so far as this is disturbed by the bearing width of the seat. In the ordinary construction of equilibrium valves the upper diameter is made greater than the lower for the sake of permitting the insertion of a valve in one solid piece. It may be pointed out in passing that it is easy to obtain this equality of diameters if the double seat be made in two parts, and the valve also made in two parts bolted together after insertion. Of course such construction prohibits the extraction of the valve without the previous removal of the upper seat, but this objection applies with still greater force to the Erste Brünner valve, which cannot be extracted from the seat, even after the double seat has been removed from the valve-chest.

The low-pressure crank pin drives, by a vertical connecting-rod, the horizontal arm of the bell-crank, seen in Fig. 2, which operates both air pump and feed pump. These are horizontal, and have the same stroke, having one common rod. The air pump is double acting, with a very deep piston, cast hollow. The suction and discharge valves are circular rubber discs, the suction being made considerably larger than the delivery. These pumps are placed at a considerable depth under floor level.

We regret that the drawings at our disposal do not permit us to describe the detailed construction of the governor. It may be called a compound governor; compounded of two centrifugal balls acting in the usual way, and of a fly-wheel running loose on the shaft but attached by springs to the part on which the centrifugal balls are pivoted. The springs exert a tangential driving force on the fly-wheel which becomes almost zero so long as constant speed is maintained, but the fly-wheel runs ahead or falls behind when retardation or acceleration of speed occurs. By this means a combination of stability and time-sensitiveness is obtained.

The governor of this engine is one of the most interesting parts of the design, as it embodies a principle which has from time to time been advocated, but which has been carried out, so far as English engine making goes, only once to our knowledge. The Erste Brünner governor at the Exhibition is entirely enclosed, so that external inspection gives no clue to the construction, and the printed brochure supplied by the company gives a description—unintelligible without the aid of drawings—of a different form to that actually in use, although it embodies the same active principle. We are not at liberty to publish the drawings very courteously lent to us, nor to describe in detail the very ingenious mechanism, but permission is given to explain the mode of action, which can be done quite shortly.

To alter the cut-off the excentric is slid across a square block keyed to the shaft. This is done by a pin surrounded by a small square slide block fitting in a short radial slot cut in the disc of the excentric. This pin, which thus shifts the excentric to alter the cut-off, projects from the end flange of the case which covers in the whole of the governor mechanism. This case is really a hollow fly-wheel mounted loosely on the shaft. The fly-wheel is carried round along with the shaft by a spring connection, the spring being of flat-coil form. Inside the fly-wheel box there are two centrifugal masses of lever form. These are pinned to the fly-wheel, and their heels, or lever ends, press against brackets fast on the shaft. The effect of the linkage is that, when the centrifugal masses move outwards, the fly-wheel is displaced backwards round the shaft, while at the same time the coil spring is tightened up. So long as the rotational speed remains uniform, the force of the spring is wholly transmitted through the fly-wheel to the balls, and thus the spring provides the centripetal force balancing the centrifugal pull of the two masses, the spring centripetal force increasing as the masses fly outwards. But the other effect is that any backward displacement of the fly-wheel round the shaft is necessarily accompanied by an outward movement of these masses independently of any change in either spring force or centrifugal force. Thus, as soon as any acceleration of velocity occurs in the shaft, this double displacement—of fly-wheel backwards and balls outwards—does actually take place without the delay, or interval of time, needed to integrate this acceleration of velocity into any finite increase of velocity, that is, before the centrifugal force increases in virtue of increase of speed. This is so because the fly-wheel cannot partake in the acceleration of speed until there is exerted upon it an increase of turning moment corresponding to the acceleration of speed and to its mass inertia. The wheel is only carried round by the pull of the spring, so that this increased turning force can only be exerted in virtue of the spring being further coiled up, which coiling up only occurs along with a backward displacement of the fly-wheel. Otherwise stated, as soon as acceleration arises, the inertia of the fly-wheel absorbs some of the force of the spring, leaving less of this force transmitted to exert inward—centripetal—pull upon the balls, which latter, therefore, at once move outwards without their needing to exert increased centrifugal force.

As it is the pin on the flange of the fly-wheel that shifts the excentric, the alteration in the cut-off gear anticipates the integral change of speed. The shifting of the gear affects the cut-off only once in every semi-revolution, so that an integral change of speed may accumulate before any effective change of cut-off occurs; but in the present engine, the speed being fairly high, this is of no importance, a semi-revolution occupying only a quarter of a second, which is too short a period for the accumulation of any appreciable change of speed.

This inertia action of the fly-wheel is, of course, only temporary and momentary. After it has fallen back through only a very small angle, it has stretched the spring, so that this supplies sufficient extra force to make the wheel keep pace with the shaft, while at the same time the increased radius to which the balls have moved outward has also somewhat increased their centrifugal pull upon the wheel. As soon as the acceleration of speed stops, the inertia of the wheel no longer absorbs any part of the spring force, and the increase of this force due to the stretching of the spring is now available for balancing change of centrifugal force in the balls, due to their having shifted to a greater radius and due to integral change of speed.

During retardation of speed the mechanism acts in exactly the reverse manner to that already described.

This utilisation of a combination of rotational inertia force, acting momentarily, with change of centrifugal force acting more permanently, gives the governor regulation of the engine very quick action, or time sensitiveness, along with the needful stability.

MERCHANT SHIP DEVELOPMENT.—The Committee on Shipbuilding and Engineering of the forthcoming Glasgow International Exhibition, having remitted the matter to a sub-committee, consisting of Mr. John Henderson, convener; Dr. John Inglis, vice-convener; and Mr. T. J. Dodd, of Lloyd's Registry of Shipping; that sub-committee is obtaining from builders and engineers all over the country models representing outstanding types of merchant ships and new departures in naval architecture, which will form as a whole a speaking history of the development of merchant shipping during the nineteenth century. This historical collection will be grouped chronologically, and the arranging and descriptive cataloguing is being undertaken, at the request of the Committee, by Mr. David Pollock, M.I.N.A., Glasgow.

WELDLESS STEEL CHAIN PATENTS.—The Court of Appeal of the German Patent-office has just given its decision in an appeal by Mr. Otto Klatte, a German manufacturer, against the grant of a patent to Mr. A. G. Strathern, of Strathern's Weldless Chains—Limited—Gartsherrie, Coatbridge, for his invention relating to the manufacture of weldless chains direct from cruciform bars of steel. Plant has been recently erected in extensive works at Gartsherrie for the manufacture of weldless chains by the process, which has been patented in this country and in Europe and America. The patent was opposed in Germany by Mr. Klatte, on the ground that he had devised a process of rolling bars to produce similar chains, and the case was decided in favour of Mr. Strathern in May last, but the decision having been appealed against, has now been finally settled in favour of Mr. Strathern, after an impartial hearing of counsel for both parties. By this decision the Scotch inventor will have the sole right to manufacture chains by his patent process in Germany.

BRAKES FOR ELECTRIC CRANES.

THE question of what brakes should be used for electric cranes meets with a by no means unanimous answer from engineers. The advocates of mechanical brakes maintain that there is nothing so safe and efficient as a mechanical contrivance thoroughly under the control of the crane driver. They say that there is nothing so trustworthy, and that a free barrel with a mechanical brake will lower a load with safety at three times the speed that any electrical appliance will permit of. They state further that all electrical brakes are mere fancy adjuncts to a crane that has got to do real work, and are more likely, by their untrustworthyness, to hinder matters than to be of any real use. Whereas, by the employment of a good mechanical brake, the saving of time and profanity to an excited stevedore, who has the job of unloading a vessel, say, on piecework, is much more important than pumping current back into the mains, as is performed by some forms of electric brakes. Moreover, the average crane-worker gets a block of wood and puts it under the magnetic brake, which thereafter remains on the "off" position.

This is one side of the question. The advocates of electric brakes are just as emphatic in the other direction. What they say is that when the manipulation of any part of the mechanism of a crane can be taken out of the hands of the driver and actuated automatically, it should be done. If things can be so arranged that on all occasions when the speed of lowering exceeds a certain maximum, an automatic brake comes into play, then a satisfactory state of affairs exists. There is, it is urged, additional advantage in favour of those cranes in which the motors are used for sending current back into the supply mains when the weight is being lowered and doing work. Particularly is this the case of dock and wharf cranes.

Mechanical brakes are too well known to need any further description. To some of our readers, however, the various forms of electric brake may not be so familiar, and the following information as to recent practice in electric brakes may be of interest.

Electrically-operated brakes as employed on electric cranes may be divided into two classes, the first embracing such brakes as alone strictly deserve the title of "electric brakes," and the second consisting of magnetic brakes in which the actual retardation of motion is caused by mechanical means, *e.g.*, the friction of a band on a drum, or of a brake block on the flange of a wheel. In the magnetic brakes composing the second class it is usual for the block to be held in the "on" position by a weight or spring, the action of the magnet being to release the brake when current is supplied to the crane motor, either for raising or lowering the load. In what follows it will be only the true electric brakes comprised in the first class that will be alluded to as "electric brakes."

In order to determine the most advantageous type of brake to be used in any given case, it is necessary, in the first place, to form a clear idea as to the precise duty to be performed by the brake. If the mechanism of the crane be non-reversible, *i.e.*, if the load cannot run down by its own weight, the motor will have to be used both for lifting and lowering the load. The only duty of the brake will in this case be to bring the load quickly to rest after current is shut off from the motor. When brought to rest the load will be sustained by the crane mechanism independently of the brake. If, on the other hand, the lifting mechanism is designed so as to be reversible—as is, of course, in most cases desirable on the score of economy in working—the brake may have any of three distinct functions to perform: (1) It may be required to retard the falling load, so as to prevent its speed exceeding some desired rate; (2) the brake may be required to bring the load rapidly to rest at the end of either the lifting or lowering motion; or, (3) it may be necessary to employ the brake to maintain the load in position after it has been brought to rest. It may at once be stated that—neglecting purely mechanical brakes—the magnetic type of brake is the only one capable of fulfilling the last-named requirement, and is for this reason the one most usually employed in connection with the lifting motor of cranes driven on the three-motor system.

For use with cranes having a non-reversible mechanism, and especially when shunt-wound motors are used, and also for such cases where functions (1) and (2) alone are to be performed, which frequently arises in the case of passenger lifts, or cranes working under special conditions, electric brakes offer many advantages. The most usual type of purely electrical brake is that in which the motor itself is made to supply the retarding force. If in a crane the inertia of the moving parts of the gear or the action of the falling load be sufficient to cause the motion of the crane to continue after current is shut off from the motor, and if the motor be still connected to the gearing, it will obviously continue to rotate in the same direction as before the current was cut off. If, now, the armature circuit of the motor be closed, the motor begins to act as a dynamo and will generate current, and the rotation of the armature will consequently be retarded on account of the work which it is now made to do. This retarding action may be made use of to arrest or regulate the motion of the crane.

As the motor most usually to be met with in crane work is of the series-wound continuous-current type, it will be well to consider, in the first place, the employment of such a motor as a brake. When the crane-driver cuts off current from the motor armature circuit by means of his controller, he at the same time cuts off the exciting current from the magnet field, since the magnet windings are in series with the main motor circuit. Except, therefore, for the residual magnetism in the field magnets, no current would be produced by closing the armature circuit. If, however, as is usually the case, there is a sufficient residual magnetic field to start a current the field will be rapidly reinforced as the current begins to flow, and enough current will be generated to make the motor offer a considerable retarding force. The amount of this force can be regulated by resistances introduced into the circuit, through which the motor is thus made to drive current.

It must be remembered that when the motor is disconnected from the source of supply, and driven as a generator, the direction of the current in the armature will be reversed, since the motor has now become a dynamo. The connections between the armature and field magnet coils must therefore be reversed at the instant of cutting off the main current, in order to avoid reversal of the magnetism of the field; hence, the reversing switch in the armature circuit must be moved over from the "lifting" position to the "lowering" position, or *vice versâ*, before the motor is short-circuited. This can, of course, be arranged for by a suitable arrangement of the contacts on the controller drum, the connection being automatically made when the handle is moved into the "brake on" position. The current generated is at first weak, but soon strengthens the magnetic field, and becomes in consequence stronger itself, and its retarding action comes into play. As the speed of the motor decreases, the resistances in the circuit are cut, one by one, so as to maintain the breaking action approximately uniform. As an example of cranes in which this arrangement of electric braking has been actually carried out may be mentioned the 2½-ton wharf cranes built by the firm of Mohr and Federhaff for the Versmannsquai at Hamburg. The eletrical equipment for these cranes was supplied by the Schuckert Electrical Company of Nuremberg. If the crane motor be shunt, instead of series-wound, the controller connections are rendered simpler. In order to stop the motion it is necessary to disconnect the motor armature circuit from the supplying mains and then to close the circuit through resistances having the same purpose as the resistances mentioned in the case of the series motor above described; in this case also further positions of the controller handle short-circuit these resistances as the speed of the motor decreases. During the whole of these operations the field magnet windings of the motor should remain in uninterrupted connection with the supply mains. The motor is thus made to act exactly as a generator, having separately excited magnets. An alternative method of connection would be to cut off the magnet circuit from the mains and to send the current generated by the motor through them. The motor would thus work as a series dynamo exactly as described above. A modification of the arrangement above described, which may under certain conditions be productive of considerable saving in the amount of power absorbed by the crane, may be made in the case of shunt-wound motors. Instead of short-circuiting the motor through a resistance, it may remain connected to the supply mains, and, when acting as a brake, may be made to send current into the mains, and thus perform useful work. In the case of cranes used to lower cargo from a wharf into the hold of a ship it has been found possible to reduce the average amount of power used very considerably by the employment of motors working in this way. If, when the load is being lowered at the desired maximum speed, its weight supplies just sufficient power to overcome the friction of the crane mechanism and the losses in the motor, the motor may be said to be rotating at its critical speed. There will under these conditions be no current in the armature of the motor. If any increase in speed occurs, the motor will begin to send current into the mains; if the speed of rotation is lessened the "counter E.M.F." of the motor will decrease and the motor armature receive current from the supply main. The torque in the motor shaft, of course, changes in direction as the "motor" becomes a "generator," or *vice versâ*.

Let e = E.M.F. of the motor acting as generator.
E = pressure of the mains.
C = current generated by the motor.
R = resistance of the motor armature.
then $e = E + CR$.

The quantities E and R may be considered as remaining constant; thus e and C will always increase together; the value E C of the energy given to the mains will almost exactly balance the surplus energy of the falling load, however much the load may be increased. There is, therefore, found to be only a slight percentage of increase in the speed of the motor above the "critical" speed, even for very considerable increases in the load. We thus see that a shunt motor may be made to adapt itself quite automatically for use as a speed regulating brake. There is no possibility of sudden jerks when the motor begins to act as a retarding power, instead of an accelerating one.

The series motor, which from its other self-regulating properties is pre-eminently the most suitable type of motor for crane work, has no "critical speed," and cannot, therefore, be used in this way to store the energy supplied to it by a falling load. Some actual figures obtained in practice with shunt motors, when allowed to supply current to the mains, may be given. The figures apply to some 30-cwt. wharf cranes working at the Hamburg Dock. There is a great difference in the saving effected according as the crane is used to load or unload a cargo. In the former case the loads have to be lifted about 13ft., so as to clear the obstructions on the quay, and are then lowered about 52ft. into the hold of the ship. In unloading, there is conversely a long lifting operation, and only a short lowering one. The speed of lift is about 120ft. per minute at both full and half load. When lifting the full load, the maximum efficiency of the crane mechanism was 81 per cent., and accordingly about 15 horse-power was required. The efficiency of the motor at full load was 87 per cent. Hence, 17·3 horse-power of electrical power was absorbed by the motor when lifting the full load. When driven by the falling load the efficiency of the mechanism was less, since the frictional losses subtracted from, instead of adding to, the apparent weight of the load. The efficiency was found to be 79 per cent. under these conditions. The motor efficiency at the lower output was found to fall to 82 per cent. The total rate at which energy was returned to the mains was found, therefore, to be only 7·65 horse-power.

At half-load the power absorbed in lifting was 10·01 horse-power, and the power regained when lowering 3·85 horse-power. When calculated out for the complete operation of loading a ship, it was found that, when the crane lifted full loads, 83 per cent. of the energy expended could be recovered. If the crane only worked at half-load 49½ per cent. was obtained. In unloading a ship the corresponding figures were only 6½ and 3·9 per cent. respectively, owing to the relatively small distance through which the falling load could act. The combined saving in loading and unloading equal cargoes amounted to 27 per cent., when full loads were operated upon, or 16 per cent. with half-loads. The figures just given show the economy to be obtained with a shunt motor in a very favourable light. They would, however, hardly be obtainable in everyday working, and, as has been already pointed out, shunt motors are not suitable for crane work as regards starting torque, and self-regulation in the matter of speed. It may be noted that three-phase motors may be made to act as generators, and thus regulate the speed of a falling load in a similar manner to shunt-wound continuous current motors. The magnet exciting circuit must in the same way remain connected to the mains. The armature may then be made to supply useful current.

Eddy-current brakes have been supplied by some firms of crane makers. The principle upon which these brakes act depends upon the local eddy current set up in a mass of iron when magnetic lines of force are made to move rapidly across it. Such eddy currents, when produced by a magnetic pole moving rapidly in the neighbourhood of the iron mass, themselves produce a magnetic field. The lines of force composing this field are such that they tend to attract the magnet producing them, and to retard its motion.

A typical form of such a brake may be described as follows:—The braking action takes place between two concentric discs having their faces placed near together. One disc is made to revolve with the rotating shaft which is to be braked, while the other is prevented from rotating. A projecting rim on the face of the fixed disc carries a coil of wire, through which a current is sent when the brake is to be applied. On the face of the rotating disc are studs or cast projections arranged in two concentric rings or series, one set of projections being set at such a radius as to be able to rub against the face of the fixed disc just inside the wire coil, while the other set consists of similar teeth which are just outside of the coil. The two discs are mounted so near together that the coil on the fixed disc lies between the projections of the rotating disc. The discs are held apart by a spring, the projections being thereby just prevented from rubbing on the face of the opposing disc, except when the force of the spring is overcome by the electro-magnetic attraction between the two discs set up by the induced eddy currents. The action of a current flowing in the coil will be to excite polarity in the projections lying on each side of it. Moreover, the polarity of the inner and outer circle of projections will be of the opposite character. As the shaft carrying the disc rotates, eddy currents will be induced in the fixed disc by the travelling poles, and the discs will be attracted together, their mutual attraction overcoming the force of the spring separating them, and thus adding mechanical friction to the retarding action due to the eddy currents. Brakes of this type may be made very powerful in their action, and have been used as axle brakes on electric railways.

From the circumstance that none of the purely electrical forms of brake described above are capable of holding the load after it has been brought to rest, they would, under most ordinary conditions of working, have to be arranged to work in conjunction with a mechanical brake, the duty of which would be to lock the load securely when brought to rest by the electrical brake. It is, therefore, not likely that electrical brakes of this character will displace the usual magnetic brake as applied to the lifting gear of cranes. It is not, however, so much in connection with the lifting motion of cranes that attention need be drawn to electric brakes. The travelling, traversing, and slewing motions of a crane, when performed at the speeds which electric power has made possible and economical, must be capable of being checked rapidly. No doubt a simple way of checking the motion is to reverse the controller handle, and this is very frequently the only means available. This cannot, however, be considered to be an economical method, and the strains on the controller and mechanism of the crane are very severe.

For bringing the crane rapidly to rest, without shock and without waste of current, when travelling, or slewing, electric brakes have features which strongly recommend them. No additional mechanical parts whatever are rendered necessary, and no additional complication need be introduced into the handling of the crane. Two or three "braking positions" for the controller handle next to the "zero position" is all that is required. The addition of corresponding contacts on the cylinder of the controller, with their connections to the necessary resistances, cannot be called a heavy addition to the cost of the crane, and this is all that is needed in order to add an efficient means of speedily checking the motion of the crane upon shutting off current. In overhead travelling cranes having a high rate of travel, the increased safety and certainty in working, when the driver has learned to trust to the electric brake, are very noticeable. Some form of electric brake, such as those described above, certainly seems to merit a more extensive adoption than it has hitherto met with amongst crane builders in this country.

MR. PRICE, of the Cape Railway, has been in Wales lately, and has enlisted a large number of railway employés for service in South Africa.

PLATE GIRDER FOOT-BRIDGE

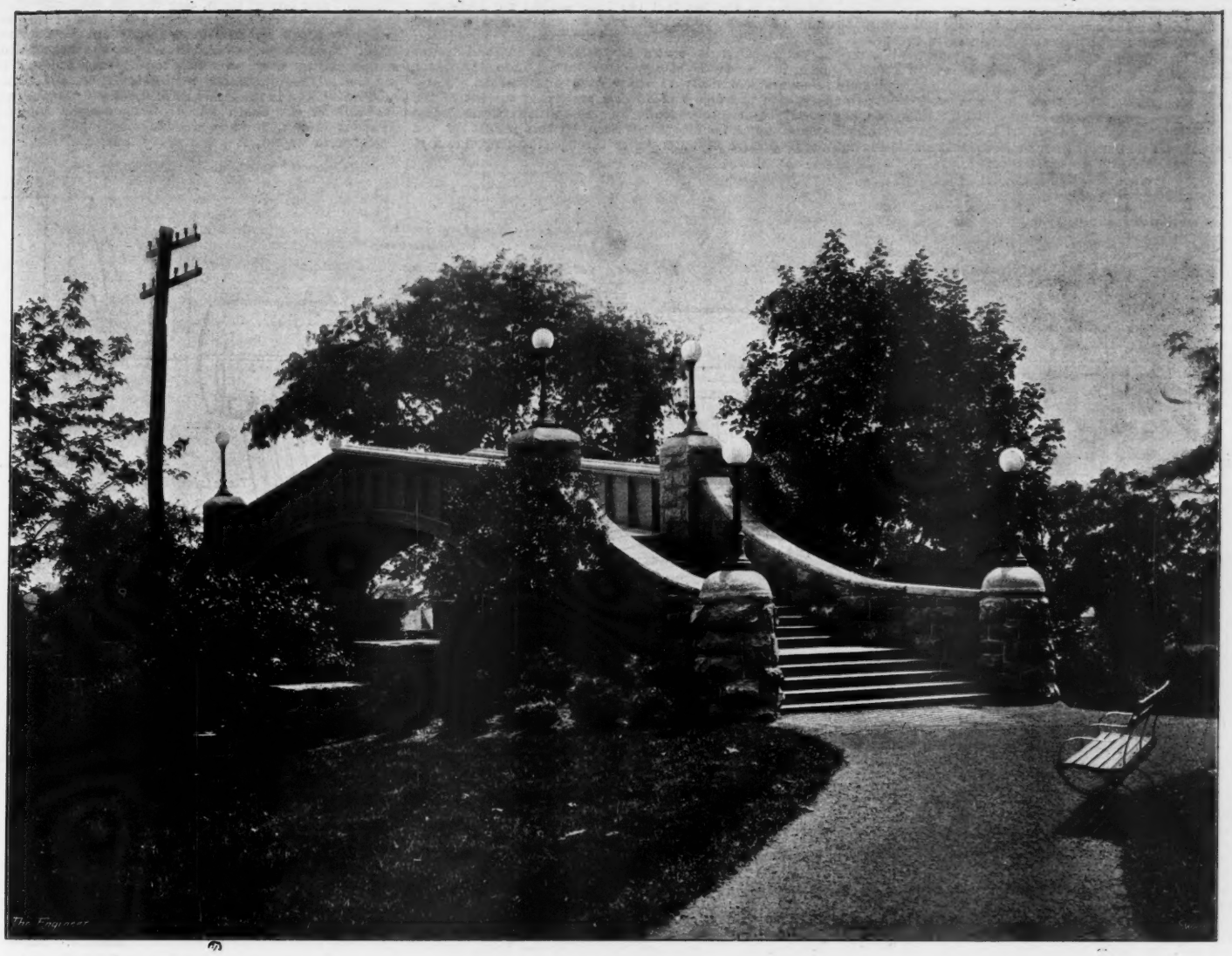
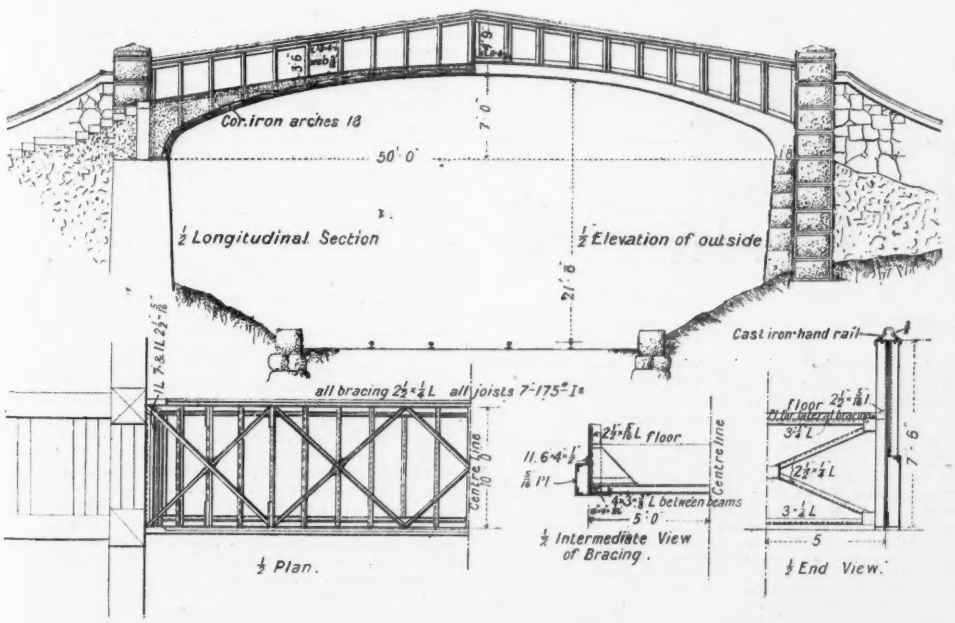


PLATE GIRDER FOOT-BRIDGE AT MADISON, N.J.

We illustrate in the above engraving a foot-bridge at Madison, N.J. This structure consists of two parallel arched plate girders carried by masonry abutments, which also form the stairway approaches. The girders have a span of 50ft., and are placed 10ft. apart centre to centre. We give also a part longitudinal section and part side elevation, and also transverse sections near the abutment, and at an intermediate point between the abutment and crown. It will be noticed that the outside of each girder is provided with a projecting fascia on its lower part, varying in depth from 9in. at the crown to 3ft. at the abutments. This fascia gives the bridge the appearance of a thin arch carrying a solid plate railing. Besides the transverse bracing indicated by the two transverse sections, there is a lateral X bracing below the floor beams. The floor is formed by corrugated iron arches sprung between the floor beams, and filled above with concrete, which carries the footwalk paving. Above we give a general view of the completed structure, and it shows quite well the manner in which the metal structure harmonises with the masonry abutment approaches. The bridge contains 27,500 lb. of steel, and 550 square feet of corrugated iron. It was designed by Mr. H. G. Tyrrell, assistant engineer, Boston Bridge Works, Boston, Mass., to whom we are indebted for the matter from which this description has been prepared.



STEEL FOOT-BRIDGE AT MADISON

REFUSE DESTRUCTION AND STEAM RAISING.

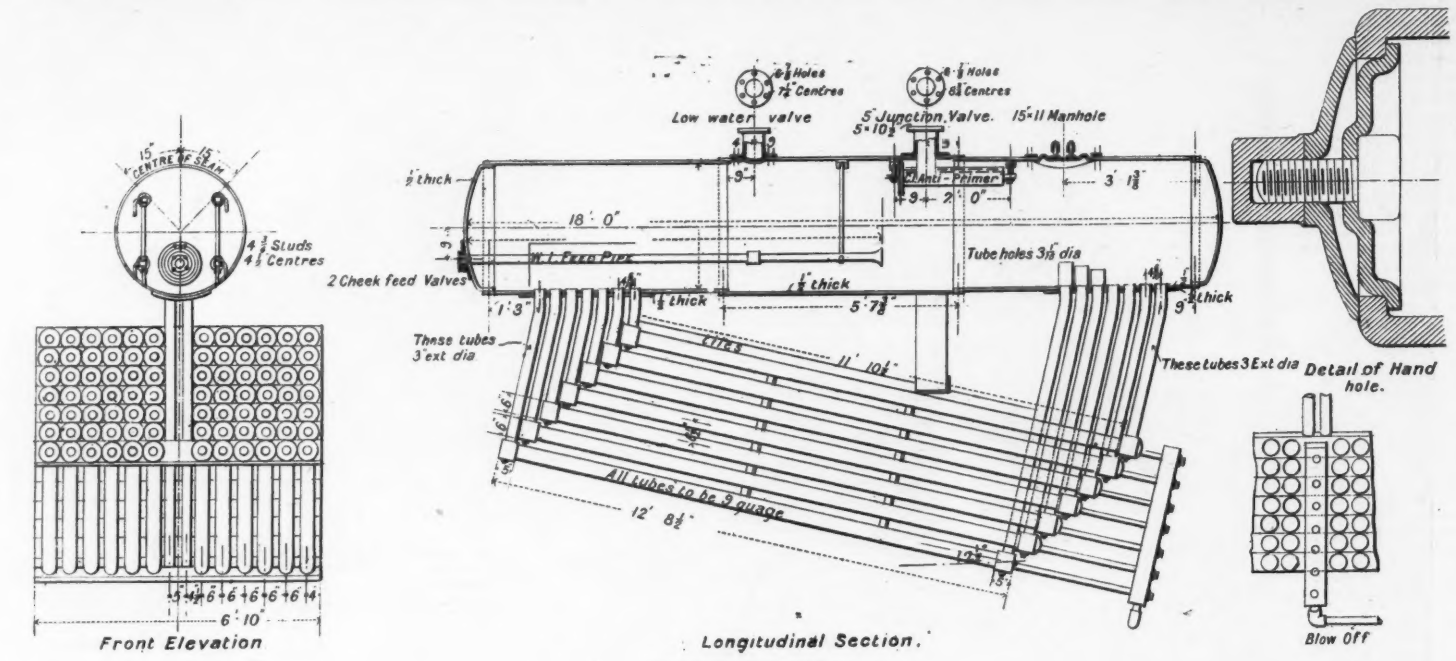
The destruction of town refuse is a subject the interest in which has been greatly increasing during the last few years, and many engineers have made it a special study. As a result, there are a great number of types of destructor at work, all claiming to have special features. Our illustrations show the "twin-cell" destructor, which has recently been brought out by Heenan and Froude, of Manchester. This destructor is claimed to differ from those which have gone before in that it has two grates separated by a dividing wall. In the illustration the two cells are called A and B and the dividing wall C. Above the grates and dividing wall, and at right angles to the latter, is a fire-brick arch E. This does not, of course, reach from end to end of the length above the grates. Passages F and F^1 are left at either end, and these lead into a combustion chamber G over the top of the arch E. The products of combustion pass from the combustion chamber or flue G to the flue H, and thence to the chimney, either direct or through a boiler, there being a second combustion chamber above the arch K. The outlet from flue G is fitted with a damper L, by which the draught can be directed either to one side or the other. Thus when the damper L is in the position shown the cell B is in full work and at its hottest, and cell A has recently been clinkered and just re-charged. The heated gases from cell B have two courses open to them. That through F_1 can get right away, as already explained; no gases, however, can get through F past the damper L, and therefore they impinge upon the refuse in cell A and dry it. The noxious gases coming from A in consequence of this drying, and any combustible matter carried over the bridge C by the draught, are met by the flames from the fire in cell B and consumed, the harmless products of combustion passing away through the flue F^1. The arches E and K are also kept at a white heat, and help in the combustion. Thus, before the charge in cell B is consumed and is ready for clinkering, the charge in cell A is properly dried and will easily burn; indeed, when the destructor is working before the charge in B is entirely consumed, the fire has struck back and the fire in A has reached its maximum temperature. When the time comes for the cell B to be clinkered and to receive a new charge, the damper L is thrown over so as to prevent the passage of gases through F_1, and to allow them to pass through F. The process then goes on as previously described, saving that the fire is now in cell A, and the charge in B is heated and dried.

The makers claim that, by the use of this twin-cell destructor, absolute combustion of all combustible material can be obtained. They further claim that this form of destructor has the advantage as regards efficiency over the single-cell destructor using a separate cremator, in that a continual intense heat must exist in one of the adjoining furnaces, whereas where a separate cremator is used the re-charging of the fuel must result in a very fluctuating temperature. Moreover, it is claimed that a separate cremator

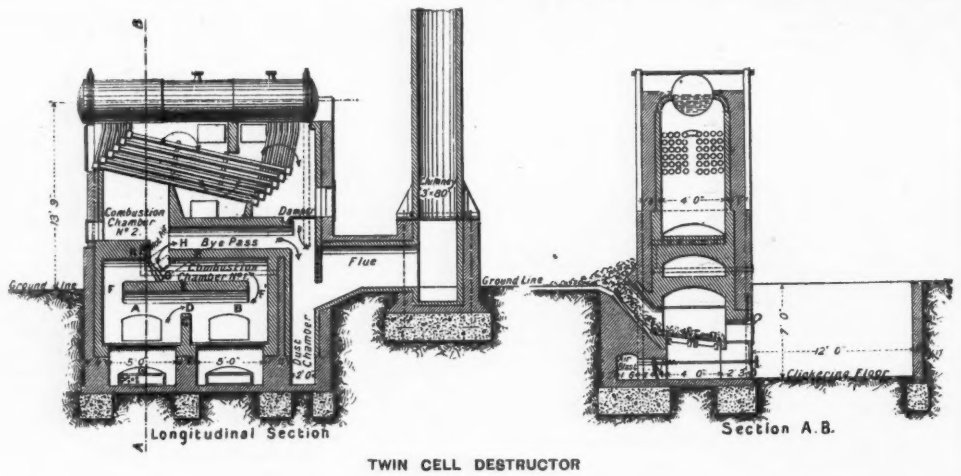
system must be more expensive, since it is necessary to use other material than refuse for the cremator part of the apparatus. The general construction of the destructor is well shown in the two sections which we give. It will be observed that forced draught can be applied on the underside of the grates. The blast is fed to the underside of the ashpit, the grate being supplied with air blast by fan, and the steam blast by a jet. The capacity of a destructor of this size is fifteen tons per day of twenty-four hours, and the space it occupies is some 24ft. by 18ft. 6in. exclusive of the chimney. We are informed that a fifty-ton plant occupies a space of 44ft. by 50ft. As shown the charging door is on the ground level, and the clinkering floor is 7ft. lower in an excavated pit. Of course this arrangement could be modified if necessary, and the clinkering floor placed on ground level, the refuse being charged into the destructor from a raised platform. Between the charging door and the grates there are large inclined hearths, and on these the refuse is partially dried before it is drawn forward on to the grate. The charging and clinkering doors are so placed that it is possible to either push or pull the refuse on to the grate, or both courses may, if necessary, be resorted to.

There is a number of these destructors at work in different parts of the country, and for the past two years the makers have been operating one of them for the destruction of the refuse of Farnworth, near Bolton. This, we understand, has been working very well indeed. Here a boiler has been installed in connection with the plant, and a considerable amount of success appears to have been met with in raising steam by means of this combination. It is stated that with this and other plants sufficient tests have been carried out to demonstrate that more than twice as much power is produced as is required to drive the forced draught apparatus, to provide for the steam jet, work a mortar mill for grinding the clinker, &c. This surplus power may be usefully employed. With this destructor it is claimed that an evaporation of 1 lb. of water can be obtained from the burning of 1 lb. of ordinary refuse. We find in a report made to the Gloucester Corporation by Mr. Read, the City Surveyor, and Mr. Robert Hammond, that, in the case of the Gloucester refuse, a guarantee was given by the makers to evaporate 1¼ lb. to 2 lb. of water from and at 212 deg. Fah. per pound of refuse. But simply taking 1 lb. of water, one ton of refuse would evaporate a ton of water. The makers allow some 350 lb. of steam as enough to provide the necessary power for the blast required by one ton of refuse. This would leave 1900 lb. for other purposes. At present prices the cost of Lancashire slack to raise 1900 lb. of steam is, say, 1s. 3d. Allowing the cost of handling the refuse after tipping, for a plant of 50 or more tons a day, to be 9d. per ton, there is a saving of 6d. per ton to go towards the cost of collection. Then there is the value of the residual clinker for the manufacture of slabs for paving or of mortar for building purposes.

Apparently this destructor can be fitted with any kind of boiler. There are instances where it is applied to the Lancashire type, and also to water-tube boilers. The boiler which the makers state is the most efficient and economical for the purpose, though any type of boiler may be employed, is that shown in our illustrations. It resembles the Babcock and Wilcox boiler in general construction, but differs from it and other boilers in material particulars. The principal difference is the fact that the tube headers are horizontal, and that each horizontal row of tubes is a separate system in itself, and has an unrestricted circulation of water, as it is connected to the steam and water drum independently of any other row. Thus the lower tubes are less likely to suffer from over-heating. Moreover, with the object of further preserving the life of the lower tubes, the tubes connecting these with the drum project some distance up into the water. By this means the less impure portion of water passes through these rows, and in addition an independent blow-off is given to the bottom row. Each horizontal row of tubes is free to move, owing to expansion or contraction, in any direction. It will be seen that the way in which horizontal headers have been obtained is by means of setting each successive header back far enough to miss that immediately preceding it. The down tubes are connected to the middle of the underside of the barrel, and of necessity the main tubes are divided, as it were, into two portions, there being a gap with a certain number of tubes on each side of it. It is claimed that a greater efficiency is obtained by this increased passage for the heated gases to pass through and by reason of the greater deflection of these gases. Beyond what has already been said the boiler needs no further description than is obtainable from the illustration Like the destructor, it is made by Heenan and Froude. Its working pressure is 160 lb.



WATER-TUBE BOILER



TWIN CELL DESTRUCTOR

THE Institution of Mechanical Engineers: Graduates Association.—The second meeting of the present session was held on Monday, the 12th inst., at the house of the Institution in Storey's Gate, Westminster, Mr. J. I. Thornycroft, F.R.S., in the chair. The meeting having been opened, the Chairman called upon Mr. J. S. Warner to read his paper on "Electric Vehicles. The author opened his paper by describing the three types of electric motors most used at the present time on electromobiles, *i.e.*, series, compound, and shunt-wound machines. He considered the latter type preferable, as it permits recuperation of the batteries by allowing the weight of the car to drive its motor as a dynamo when running down hill. The author stated he was able to make useful recuperation on gradients down to about 1 in 10 on a car weighing only 5 cwt. complete with battery. He then went on to describe the Seccoll accumulator, which was originally introduced into England by C. E. Lee, of Chicago; it has since been developed up to 270 ampère hours capacity, and has a 2·5 volt nominal reading, and gives in a 5-hour rate of discharge an average voltage of 2·2. It may be discharged down until only reading ·5 volts without injury to the cell, which by polarisation automatically protects itself from harsh treatment. A car fitted with sixty of these cells carrying the passengers ran sixty-five miles on one charge. The author then gave some particulars of tests he had made with various batteries, and so concluded a most interesting paper. A good discussion followed.

THE SOUTH WALES COAL POSITION.

THERE has been too hasty an assumption in certain circles that the recent fluctuations in South Wales coal prices indicate what financial journals are in the habit of calling a "slump," and one of them, and not the least respectable, went so far as to say that the steam coal trade of that coalfield had begun an irretrievable slide on the downward grade. No doubt prices reached their zenith for the present, and possibly for ever, when they touched 28s. and even 30s. per ton. Those quotations were exceptional, and so they were understood in the local markets, and so also they were described in our South Wales correspondent's comments. At the moment there was a pressure of tonnage at the ports, orders were urgent, it was holiday time, and the colliers rose superior to the allurement of from 10s. to 12s. per day for the sake of making a self-denying carnival.

No one in the trade ever believed that a rate of 30s. per ton could be maintained for a month, and it only prevailed for a week or two. It was an emergency incident, which it would be misleading and absurd to convert into a standard of comparison, as appears to have been done by the authors of the idea of a "slump." To remote outsiders it will appear strange at first sight to be told that winds and waves have little less to do with variations in the South Wales market than the ordinary laws of supply and demand. The association of circumstances would not be so surprising if the fact were recalled that the bulk of the steam coal output is destined for shipment abroad; that the material itself is in its essence, and because of its peculiar excellence, incapable of being "stacked" as in the Midlands, or of bearing any sort of exposure to the weather without positive deterioration of its quality. A strong easterly or north-easterly gale causes a whole fleet of coal ships to shelter under Lundy Island or in one of the havens further west. Newport or Cardiff merchants know where the vessels are, but are, nevertheless, helpless, and the charterers of the few steamers actually in dock have the appointment of prices, within reasonable limits, almost in their own hands. The wind changes or the weather moderates, and the steam colliers come up with a rush, the docks are filled, the tables are turned, the merchants have the upper hand this time, and coal, which had declined as much as 2s. per ton, recovers its equilibrium, and advances perhaps 2s. to the better. These conditions do not obtain elsewhere, except possibly on the Tyne and Tees, and not so much there because of the smaller proportion steam coal holds to the total mineral export. But their particular applicability to the British Channel coal ports should be kept in mind for any serious purpose of calculating the fluctuations in prices and their meaning as regards a "slump."

For comparison we will refer to our own price list at the beginning of the year—THE ENGINEER, January 19th, page 78—in connection with which, oddly enough, our correspondent writes:—"The rough weather of late, preventing the arrival of tonnage, has had some effect in lessening the excitement in the coal trade." As a consequence, "a slightly easier demand for steam coal was the most notable feature of the week." Best Cardiff coal was quoted then at 27s. 6d. to 30s.; seconds, 25s. to 26s.; and best Monmouthshire, 23s. to 24s. This extract describes the top figures of the year; but 27s., or thereabouts, ruled the market pretty well throughout the spring. We turn next to the midsummer account—THE ENGINEER, July 6th. It reported a large Government contract at prices ranging from 22s. 6d. to 23s. 9d.; and that best Cardiff coal was quoted on 'Change 24s. 6d. to 28s., and best Monmouthshire 21s. to 21s. 3d. After July the rates rallied again, and again subsided, more for want of tonnage than because of this action of the miners. Our last week's report mentioned "a slight falling off in the demand for steam coal, prices weakening a little, in greater part owing to delayed tonnage." Best Cardiff was then said to be 21s. to 22s.; best Monmouthshire, 18s. 6d. to 19s. 6d.; and the remark was added that "the continued high prices of seconds steam—19s. to 20s.—is a notable fact." Moreover, another Admiralty contract had been concluded in the preceding week, for 250,000 tons, to cover twelve-months delivery, at from 20s. 3d. to 21s. The contrast between January prices and those of November seems abrupt in its result, and on the surface of it makes a reduction of 6s. 6d. per ton on Cardiff "best," and 5s. 6d. on best Monmouthshire. The abruptness, however, disappears when the graduations of the transition are considered. Unquestionably it is a large abatement, but it scarcely affects the colliery proprietors so much as it must affect the middlemen; and it leaves current prices, on an apparently stable basis, at a higher average

level than they have attained to since the "booming" times of 1873-74, when, so far as we can trace the market lists, the highest quotation for Welsh steam coal was 27s. 6d. per ton.

Of course there is no "slump," but there is a visible reduction of the inflated rates of January last; and the questions just now under discussion relate to the causes of the decline, and whether it will continue. It may be postulated, we suppose, that Admiralty contract prices are satisfactory and profitable, and form a gauge by which quotations for other undertakings of the kind will be measured for another six months to come. The high scale of wages—relatively higher than it has ever been in South Wales before—really need not be brought into consideration. Under the Sliding Scale the miners' wages are advanced upon past and not prospective profits or selling prices, so that this item of expense is, or theoretically is supposed to be, discounted before the coalowners enter upon new transactions. There are two indubitable facts which count both ways. The slackness in the iron and steel trades, and the winter falling-off in some of the manufacturing industries, are bound to end in a reduction of the demand. On the other hand, when prices were abnormally high, as at this time last year, or so recently as January this year, the authorities of foreign coal depôts bought sparingly, and will perforce have to renew their stocks, while there is still the South African war going on, and the need for transports, and, necessarily, the call for more coal, which, if it be not South Wales coal, must be a fuel which, somewhere and somehow, Welsh coal will be required to replace. That is as to the future, and, further than describing the situation, on that point we have nothing further to say. But as to the causes of the drop of 6s. 6d., or, rather, as to the cause of the present level of about 21s. for best Cardiff coal, there are more trustworthy facts to deal with. By the way, eighteen months ago, a shoal of prophets were declaring that coal could not reach a guinea a ton by Christmas. It did, and thereabouts it remains, and it is, according to our advices, still a remunerative price to work with. For the trustworthy facts, we have evidence of an increased output, which is sure to continue until the winter holidays set in. The Welsh collier, consistent only in his inconsistency, determined to have a Friday's "play-day," and had it, at the risk of the law; and then, having checked the output for one day in the week, he buckled-to with renewed energy to earn his full week's money by raising the weekly output somewhat above the average. The signs of a larger output during the last three weeks are seen in the increased traffic receipts of the coal railways. And that larger yield of coal coincided with a still continuing shortage of tonnage, so that once more, as at the beginning of the year, coalowners and merchants have been confronted with something like a glut of a commodity which they had no convenient means of despatching to its customary bourne.

THE PARIS EXHIBITION.—SOCIETE SUISSE, WINTERTHUR.

This firm exhibited four railway locomotives, a tramway locomotive, and an electrical locomotive, all of very fine workmanship. Of these engines we illustrate four as a supplement.

The first of these has been constructed for the Chemin de Fer Ethiopean. The railway company asked for engines suitable for working a metre gauge line about 186 miles long, with ruling gradients of 1 in 33, the load, including the tender but not the engine, to be 85 tons; the speed to be about 18 miles per hour; the load on each axle not to exceed about 8·5 tons. The conditions were met with engines of the type we illustrate, the "Lion."

This engine has six coupled wheels and a Bissel "pony" in front. The engine is non-compound, with outside cylinders, and Walshaert's valve gear. The tender is carried on two four-wheeled bogies. The engine and tender are fitted with the Hardy atmospheric brake, and the boiler is fitted to burn mineral oil, "Mazout," on Holden's system, tanks to hold the Mazout being provided on the tender. The general dimensions are as follows:—

Diameter of cylinders	14in.
Stroke	21½in.
Diameter of driving wheels	4ft.
Diameter of pony wheels	2ft. 8½in.
Rigid wheel base	9ft. 11in.
Total wheel base	16ft. 9in.
Boiler pressure	170 lb.
Heating surface—	
Fire-box	69 square feet
Total	758 „
Grate	10·75 „
Number of tubes	142
Diameter of tubes	1·61in. and 1·77in.
Water in boiler, gallons	550
Weight of engine in working order	35 tons
Water in tender	10 „
Fuel	3·5 „

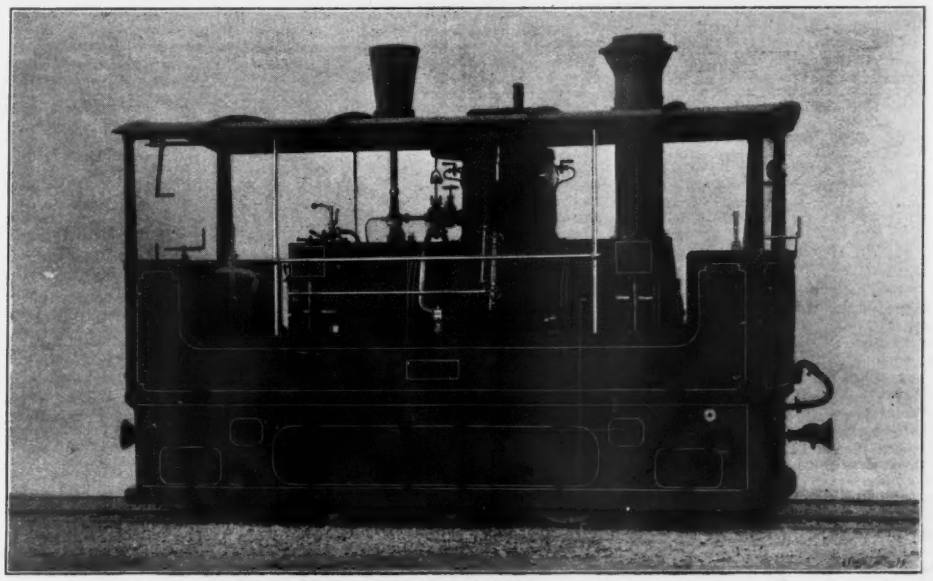
The second engine we illustrate is one of several constructed for working the very heavy Simplon traffic, a traffic which has become daily heavier, thanks not only to the augmented number of passengers, but to the introduction of dining cars and *wagons lit*. Under these circumstances the administration of the Jura-Simplon lines, finding the old engines no longer sufficiently powerful, got tenders for a new class. These engines, however, it was decided, must not be simply mountain locomotives, which are not intended for great speed, but very powerful passenger engines, capable, on the one hand, of working passenger traffic at a high speed on the more level parts of the line, climbing hills well, and fit to carry on goods traffic when necessary. In short, the demand was for a general purpose locomotive, a most difficult machine to design satisfactorily. However, the conditions appear to have been admirably met by the type exhibited. The firm took for its basis certain engines which it had constructed for the St. Gothard Railway. Seeing the great importance of the question, it was decided to construct first one engine by way of experiment. The following considerations determined the principal characteristics of the engines:—(1) The augmentation of the load available for adhesion to 45 tons on three axles; (2) an increase in the power of the boiler, and a rise in the pressure to 210 lb. on the square inch; (3) to provide for safe and easy running at speeds up to 46·5 miles per hour; (4) to eliminate the difficulties of starting a compound engine; (5) to avoid great dimensions of the cylinders; (6) the suppressing of all starting mechanism requiring special care on the part of the driver; (7) increased capacity of tender; (8) to provide power enough to haul trains of 200 tons net up inclines of 1 in 50 for any distance at speeds not less than twenty miles an hour.

An engine was put on the line by way of experiment in 1896, and succeeded so well that sixty have since been supplied of the same type. The engine is compound, with three cylinders, six coupled wheels, and a pony in front fitted wth Adams' radial axle-boxes. The single high-pressure cylinder is placed between the frames in front over the pony axle, and drives the leading pair of wheels, which have a cranked axle; the two low-pressure cylinders are outside, and drive the second pair of wheels. All three axles are coupled by side rods. The three cranks are set at angles of 120 deg. to obtain a good turning moment. The three sets of valve gear—Walschaert-Heusinger—are coupled together and operated by one reversing wheel. The slide valves are balanced. The tender is carried on three axles, and, with the driving wheels of the engine, is fitted with the Westinghouse brake.

The principal dimensions are as follows:—

Diameter of high-pressure cylinder	19·68in.
Diameter of low-pressure cylinder	21·26in.
Stroke of pistons	23·60in.
Diameter of driving wheels	5ft.
Diameter of pony wheels	2ft. 9½in.
Rigid wheel base	12ft. 10in.
Total wheel base	20ft. 8½in.
Mean diameter of boiler	4ft. 9in.
Grate surface	25 square feet
Number of tubes	238
Diameter outside	1¾in.
Length of tubes	12ft. 6in.
Heating surface—	
Fire-box	123 square feet
Total	1600 „
Boiler pressure	210 lb. „
Weight of engine in working order	54½ tons
Weight for adhesion	44½ tons
Tender, six-wheeled—	
Diameter of wheels	3ft. 4in.
Water	2500 gallons
Coal	5 tons
Weight full	29 tons

It will be seen from our reproduction of a photograph that this is a very fine engine, presenting many novel features, and essentially different from any of the systems of compounding which have been tried in this country. It is true that Mr. Webb tried, if we are not mistaken, an engine on his system with coupled wheels, but he uses one low-pressure inside cylinder, whereas the Simplon engine which we have described uses one inside high-pressure cylinder.



TRAMWAY LOCOMOTIVE, LYONS-NEUVILLE LINES

When, because of the increase in the traffic, the Central Swiss Railway Company required additional locomotives, it was decided after a somewhat exhaustive investigation to order four-cylinder compound engines from La Société Suisse. One of these engines is illustrated on our supplement. The maximum speed was fixed at 85 kilomes., or 53 miles; the diameter of the driving wheels at 5ft. 7in.; and the boiler pressure at 210 lb. per square inch. The engines were guaranteed to haul trains of 240 tons behind the tender up inclines of 1 in 100, at a velocity of 28 miles an hour. Under these conditions the dimensions set forth in the accompanying table were adopted:—

Diameter of high-pressure cylinder	18in.
Diameter of low-pressure cylinder	20in.
Stroke	23½in.
Diameter of driving wheels	5ft. 7in.
Diameter of carrying wheels	2ft. 9½in.
Fixed wheel base	8ft. 7in.
Total wheel base	23ft.
Heating surface, fire-box	160 square feet
Heating surface, tubes	1270 „ „
Grate surface	23½ „ „
Weight of engine, light	44 tons.
In running order	49 tons.
Adhesion weight	20 tons.

The tender carries four tons of coal and 2800 gallons of water, and weighs full 30½ tons. The construction of the boiler is similar to that of the Jura Simplon engine, and it is provided with a large dome and four safety valves.

The high-pressure cylinders are outside, between the bogie and the leading driving axle, and the two low-pressure cylinders, cast in one piece, are inside over the centre of the bogie. The distribution is effected for the outside cylinders by Walschaert-Heusinger gear, and for the inside cylinders by Joy gear. The combination of the two systems permits of a very simple arrangement of reversing gear, the shaft carrying the quadrants of the Joy gear serving also to transmit the motion across the engine for the outside cylinder valve gear in a way that will be readily understood from our engraving. The arrangement has worked so well in practice that the cost of upkeep has not exceeded that of the normal engine with two cylinders. In one series of these locomotives the cranks of the inside cylinders are placed at 180 deg. with those of the outside cylinders; in another series the angle is 135 deg. The low-pressure cylinders can be supplied with steam direct should the high-pressure cylinders "go blind." The tender is fitted with the Westinghouse brake. On trial the engines have run at a velocity of nearly 60 miles an hour with great steadiness.

The fourth engine we have to describe is one of several constructed for the Northern Railway of Switzerland, to the order of the locomotive superintendent, M. G. Haueter. The company asked for an engine capable of hauling 240 tons behind the tender up inclines of 1 in 100 at speeds of 28 to 30 miles an hour. It was decided that the engines should have two inside cylinders, compound, of the following dimensions:—

Diameter of high-pressure cylinder	18in.
Diameter of low-pressure cylinder	20½in.
Stroke	26in.
Diameter of driving wheels	6ft.
Diameter of carrying wheels	3ft. 1in.
Fixed wheel base	8ft. 7in.
Total wheel base	23ft. 8in.
Boiler pressure	195 lb.
Heating surface, fire-box	160 square feet
Heating surface, fire tubes	1250 „ „
Grate surface	23 „ „
Weight of engine empty	44·6 tons
In running order	50 tons
For adhesion	30 tons

In order to make room for the cylinders, the side frames are spread apart a little over 2½in. at each side, or over 5in. in all, at the leading end; the axle-boxes have been cast from Martin steel; the tubes are of soft steel, with copper ends next the fire-box; the long smoke-box contains the throttle valve, the blast pipe and the pipe forming the intermediate receiver; the fire door is in sliding halves; there is no dome, but a specially constructed collecting pipe is placed in the steam space; the leading axle, of nickel Krupp steel, is cranked; the valve gear is Walschaert-Heusinger; the slide valves are balanced; the cylinders, with the valve boxes, are cast in a single piece, and are provided with a special piston starting valve designed by the builders. Should the engine "go blind" each cylinder receives steam and works independently of the other. As soon as the reversing lever is put into such a position that the admission is 70 per cent., this valve reverses itself automatically, and the locomotive then works compound. Of these locomotives fifteen are in use, and have given complete satisfaction. The tender carries four tons of coal and 2500 gallons of water.

In a former impression we have illustrated and described a fine electric locomotive constructed by this firm. Below we illustrate a tramway locomotive exhibited by the same firm. It is for the 4ft. 8½in. gauge. It has cylinders 9½in. diameter and 13¾in. stroke. The wheels are 2ft. 7½in. diameter. The total heating surface is 270 square feet. There are nearly six square feet of grate surface. The boiler pressure is 210 lb. Its total running weight is 17 tons. It will traverse curves of 160ft. radius, and has a maximum speed of 18 miles an hour. The engine exhibited is one of many in use on the Lyons-Neuville lines with marked success.

The British Association of Waterworks Engineers.—The winter meeting will be held on Saturday, December 8th next, at the Geological Society's Rooms, Burlington House, W., when the chair will be taken by the president, Chas. H. Priestley, A.M.I.C.E., at 11 a.m. Programme:—(1) The minutes of annual general meeting, held at Cardiff, June 19th, 20th, 21st, and 22nd, 1900, will be read, and, if confirmed, signed by the president. (2) Presentation of report from the Water Boards Committee on "The Control of Water Undertakings and Sources of Water Supply." (3) Discussion on same, in which visitors will be invited to take part. (4) A resolution, "That the report be adopted and circulated," will be submitted to the meeting—members only allowed to vote. (5) A paper, entitled "The Protection of Underground Water," by Wm. Matthews, M. Inst. C.E., Southampton, will be read and discussed, time permitting.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineers: W. T. Allen, to the Duke of Wellington for the Mercury; W. H. Grant, to the Empress of India; F. Worth, to the Hood; H. J. G. Moon, to the Pembroke, additional for the Thunderer; A. Kerr. Chief engineers: W. W. Hardwick, to the Pembroke for the Sheldrake; J. A. Hibbard, to the Duke of Wellington for the Eclipse; R. B. Garde, to the Vivid, additional for the Sharpshooter, for supervision of Instruction of Engine-room Rating. Engineers: D. P. Green, to the Vivid for Keyham College; W. A. P. Smith, to the Royal Sovereign for the Banshee; E. J. Rosevere, to the Pembroke for the Haughty; W. C. Morcom, to the Pembroke, additional for the tender Contest; G. T. Paterson, to the Pembroke, additional for the Contest; G. N. Leslie, to the Empress of India, additional; J. L. Kimber, to the Pembroke, additional for the Reserve; P. Wheater, to the Wildfire, additional for the Reserve; R. W. Martell. Assistant engineers: F. Guyer and J. W. Forbes, to the Hood; H. W. L. Cocks, to the Wildfire, additional for Dockyard Reserve; R. G. Jeffery and J. H. Harrison, to the Empress of India; E. G. Pallot, to the Howe; W. G. Heppel, to the Cambridge, additional for the Conqueror. Probationary assistant engineers: W. R. Fendick and H. S. Briggs, to the Empress of India; C. C. A. Stuart, to the Hood. Artificer engineers: A. Nicholls, to the Pembroke, additional for the Porcupine; W. J. C. Plant, to the Vivid, additional for the Sharpshooter; W. J. Penrose, to the Hussar.

RUSSIAN FIRST-CLASS BATTLESHIPS—BORODINO CLASS.

We have several times drawn attention to the modern tendency to crystallise warships into a universal type. Great Britain, France, the United States, Japan, Germany, have all fixed upon a standard to which their future warships will closely adhere. With most of these we have already dealt at length; with the newest German and French designs we shall deal later.

Our present subject is Russia's standard—one of singular interest because it is a normal development of a French type that our neighbours have themselves discarded in favour of a more British design. The British design with the space between the guns and the water-line heavily armoured, has indeed permeated every navy except the Russian. It is true that the germ of the idea is Russian. The first nation to adequately protect the lower deck was Russia; now Russia alone* adopts a different system. The reason is hard to seek. The data upon which Russian designers work are unknown. All that is obvious is that the Jauréguiberry type was, at their desire, developed at La Seyne into the Tsarevitch, and upon the Tsarevitch they have grafted a few of their own ideas and evolved their own standard.

The Tsarevitch is so very like the Borodino in general design—the differences lying only in dimensions, rig, and the positions of certain tertiary guns—that we do not propose to deal with her separately. The distant ship in our illustration opposite will serve to indicate the difference between her and the Borodino class, so far as appearances are concerned; the separate plan will show the difference in mounting the 12-pounders. By way of clearly showing the processes of evolution we also append a diagram of the Jauréguiberry, of which no very correct plans have ever been published. Those current in the various naval annuals are based upon the original design, in which several minor alterations were subsequently made. They do not, also, show the armoured hoists, a peculiar feature of the Jauréguiberry. A modification of them will be noted in the Borodino and Tsarevitch.

We illustrated the Retvisan very fully some eighteen months or so ago, when she was laid down at Philadelphia, and was known as the Russian Cramp battleship "A." As this ship is more or less entirely British or American in her design we do not propose to concern ourselves with her here, beyond remarking that she carries an identical armament upon a slightly less displacement.

The data of the three ships with which we are now dealing, compared, are as follows:—

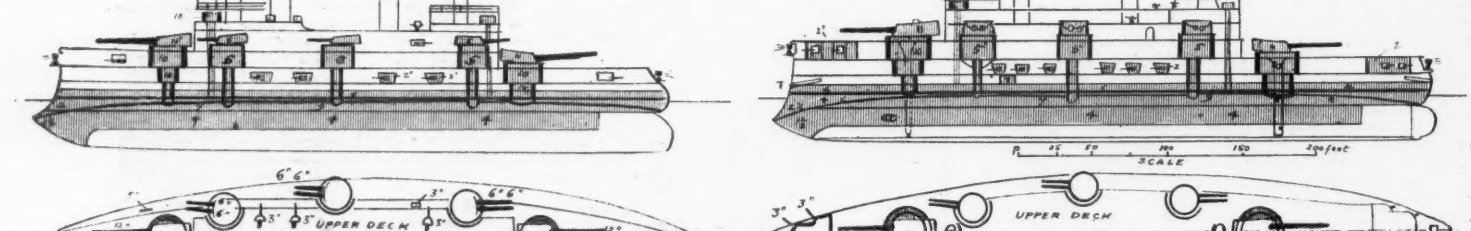
	Jauréguiberry.	Tsarevitch.	Borodino.
Armour	Creusot	Krupp	Krupp
Displacement, tons	12,000	13,000	13,566
Length, feet	387	387	397
Beam, feet	75½	75½	76
Draught (mean), feet	26	26	26
Big guns	Two 12in. / Two 10·8in.	Four 12in.	Four 12in.
Secondary guns, q.f.	Eight 5½in.	Twelve 6in.	Twelve 6in.
Tertiary pieces, q.f.	Four 9-pounders	Twenty 12-p'd'rs	Twenty 12-p'd'rs
Small quick-firers, &c.	Tw'lve 3-p'd'rs / Tw'lve 1-p'd'rs	Tw'nty 3-p'd'rs / Eight 1-p'd'rs	Tw'nty 3-p'd'rs / Eight 1-p'd'rs
Submerged tubes	2	2	2
Above-water tubes	4	4	4
Armour belt (amidships)	18in.	9in.	9in.
Belt at ends (deck)	10in., 2½in. (flat)	4ft. 2½in. (slopes)	6ft. 3in. (slopes)
Upper belt	4in.	6ft. 4in.	6ft. 4in.
Big turrets	14½in.	11in.	11in.
Big turret hoists	14½in.	10in.	10in.
Small turrets	4in.	6in.	6in.
Small turret bases and hoists	4in.	5in.	5in.
Boilers	24 Lagrafel d'Allest	Belleville	Belleville
Horse-power	15,981 (trial)	16,300	16,300
Maximum speed	18·1 (trial)	18 knots	18 knots
Coal (normal)	750 tons	"	"
Bunker capacity	1100 tons	1,250	1,250

There is some uncertainty as to whether the 1250 tons of the Russian ships is to be carried at the normal displacement, or whether it represents the bunker capacity. We incline to believe that it is the latter. Again, too, the flat deck of the Jauréguiberry has been described in France as reinforcing the belt, though we doubt it. We base our opinion on the very complete plans of her, as designed, which have appeared in the *Naval Annual*. Eighteen inches of Creusot steel will defeat most projectiles, so a curved deck would not greatly improve matters here.

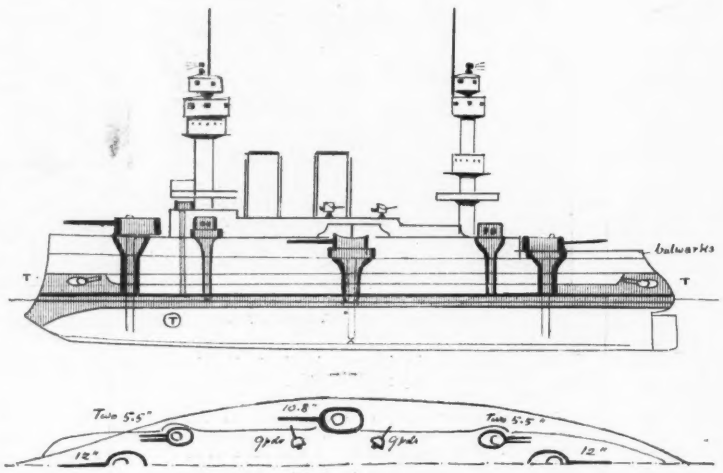
An inspection of the plans will show that the placing of the main and secondary armaments is identical, save that in Russian ships a pair of 6in. replace each amidships big gun, and the fore and aft big pieces are doubled. The armouring of these guns and the water-line protection are also practically identical, but much thinner in the Russian ships. This thinning goes to cover the weight of extra artillery. Horse-power, speed, coal, and so forth, are very nearly on a par. Most of the extra weight is spent in armour against torpedo attack—an absolutely novel idea, in which a good many people place no faith, holding that a torpedo exploding entirely in the water, will beat in any side. At the same time, this Russian design certainly offers a good deal in the way of any projectile that might strike below the belt in a heavy sea. A big gun would have to be pretty near to get through the opposition, 4in. of Harvey nickel armour on the ship's bottom, a thick coal bunker, and then a 4in. lateral bulkhead of Krupp armour. The total resistance, allowing for such weakness as two separate thicknesses may imply as compared with a single plate, certainly offer a resistance equal to 7in. of Krupp, say 21in. of wrought iron. It may not be without interest to mention here that we have seen diagrams of this ship prepared for issue to the Russian navy for use in the Jane Naval War Game. In these, the protection against hits below the belt is calculated at "*a a a*," which stands for a resistance equivalent to 10in. Krupp, or 30in. of iron. Presumably a large allowance is made for such curve as the hull has, and for the rapid motion in which the rolling target of a ship's bottom would be. Possibly the Russians like to say the best for their design. Here they have something that only a very modern 12in. or a 110-ton gun is allowed to penetrate save at close quarters of a few hundred yards. Against torpedoes, too, a heavy favour is given to the Borodino. The "scorer" states that "if this ship is attacked with torpedoes, only one-quarter of the usual chances of success are to be allowed." Again, this may be questioned; but as the matter is necessarily pure theory at present—for the ship is yet a long way from being launched—it is probably an error in the right direction. So far as other ships are concerned the protection against torpedoes or hits below the belt is practically nil, save for such resistance as wings filled with water may offer, and the triple bottoms of the Italian Sardegna class and the French Jemappes type.

To resume our description of the Borodino. The belt proper only reaches a very little way above the water. It is reinforced by a thick armour deck, also by a flat 2in. splinter deck, on top of the belt. The entire space between these two armour decks is filled with coal. The splinter deck is protected by a thinner upper belt of a maximum thickness of 6in., which rises to a height of some 4ft. above the deck proper. On this deck the above water tubes are carried, but they do not appear to have the armour protection that is usually given to such tubes in French designs.

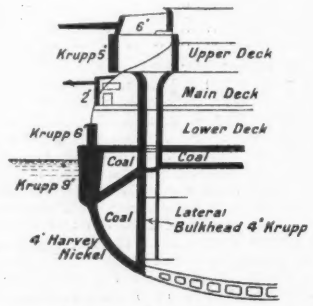
The armoured casemates on the main deck for the 3in. guns represent that novel departure already made in the Bayan, to which we devoted a good deal of space some weeks ago; it is also to be found in American designs—at any rate on paper. It appears, so far as we can gather, to be rather of the nature of a proposal than definitely decided in the American designs. It is one of those things bound to become universal; but which halts in coming into general use by reason of the truth of the proverb about eating cake and having it too. It is generally admitted that one gun behind armour is worth two without it; but until the enemy has gone behind armour the two guns stand to be preferred on account of the beating down with superior fire theory. The Russians appear to have solved the problem of armouring the 12-pounders without reducing the number, but it has to be paid for somewhere else.



TSAREVITCH BORODINO



JAUREGUIBERRY



SECTION OF BORODINO

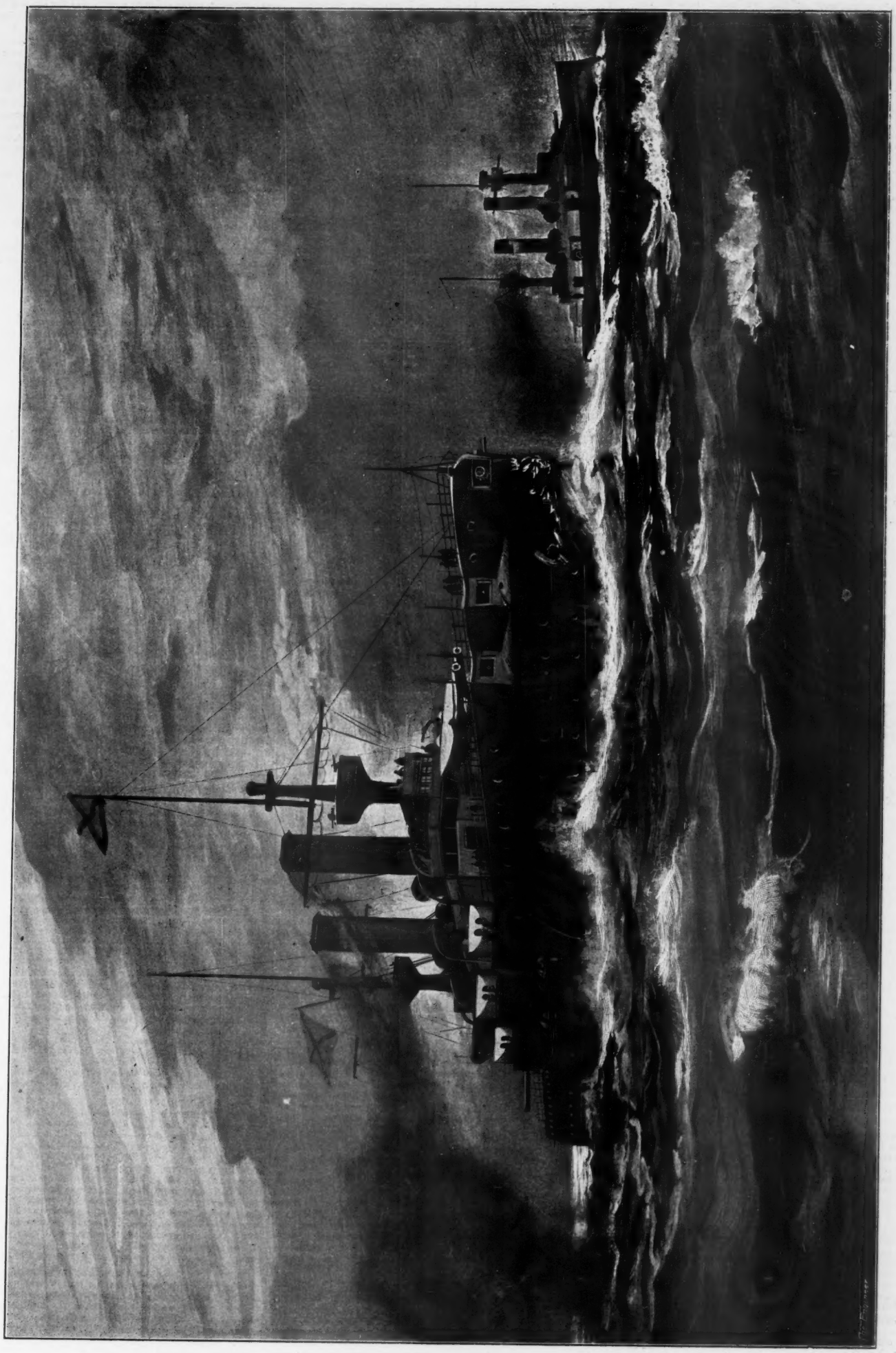
* The French design for the Gambetta is not altogether unlike the Borodino in some particulars.

BELLEVILLE BOILERS IN THE JAPANESE NAVY.

We learn that the latest enemy of Bellevilles is the Japanese navy, which "plumped" for this type of water-tube boiler, not long since, even more violently than the British. The history of how Japan came to adopt the Belleville is somewhat curious. French ships fitted with this boiler came out to the Far East, and the officers of these vessels spoke enthusiastically of the new acquisition. The Chiyoda was then fitted with locomotive boilers, the small tubes of which rapidly choked with Takushima coal. It was intended to give her cylindrical boilers, but the ease with which French ships got up steam had made a great impression, and Belleville's were ordered. An engineer officer was also sent to serve for a year in a French ship to study the boiler. In the meantime the British Admiralty "plumped" for the Belleville—for it has amounted to that. The Japanese, who, so far as they model on any navy, model on the British, took it for granted that so momentous a step could only mean that no other boilers were worthy of consideration in British eyes. They also took for granted that innumerable experiments must have been made, and on "the king can do no wrong" principle, forthwith decided to follow suit. Belleville boilers were ordered for all their new ships building in England and elsewhere—a touching example of faith in the wisdom of the British Admiralty, for Japan practically carried out no experiments herself. A certain number of stokers was trained in the Chiyoda as soon as she was ready, but the Shikishima absorbed most of these, and the Asahi and other Bellevilled ships went out with cylindrical boiler trained stokers. The result, we hear, was that the Asahi, going out at 10 knots, burnt the prodigious amount of 150 tons per diem while in the Bay of Biscay. Instead of calling, as by programme, at a few ports on the way out, she seems to have stopped everywhere where coal could be procured for her insatiable boilers. No doubt much of this excessive consumption was due to untrained *personnel*; but the coal bill was the coal bill, and its total created consternation. The natural result has been to put the Belleville boiler in bad odour; and, as we mentioned elsewhere last week, the Niclausse is now down for trial as an antidote. Curiously enough, the boiler next in general use to the Belleville—namely, the Yarrow—does not seem down for trial, nor does the Thornycroft, which is to be found in nearly as many ships as the Niclausse.

FIRST-CLASS RUSSIAN BATTLESHIP BORODINO

(For description see page 542)



RAILWAY MATTERS.

AMONG the Bills which will come before Parliament in the next session will be one for incorporating a company to construct an overhead electric express railway between Liverpool and Manchester.

THE Tramways Committee of the Manchester Corporation have now 500 men at work relaying the lines of rails for the adoption of electric traction. Of 430 cars ordered last January 190 are now in course of construction.

IT is reported that the Ebbw Vale Company has just booked an order for about 10,000 tons of steel rails for the West Australian Government. American makers quoted, but although their price is said to have been about 10s. below that of the Ebbw Vale Company, the contract was given to the latter.

A CIRCULAR has been issued by the secretary of the Southport and Cheshire Lines Extension Railway stating that a provisional agreement subject to certain contingencies has been come to with the Lancashire and Yorkshire Railway Company for the acquirement by that company of the Southport Company.

AT Southampton the London and South-Western Company has in course of construction several important additions and extensions. Amongst these is a new graving dock, which will be 800ft. long—the largest single graving dock in the world. Premises for cold storage on an extensive scale are also being built.

THE London County Council have decided to instruct the Highways Committee to ascertain from the tramways companies at what price they would surrender the lease now held from the Council—which expires in 1901—in view of the desirability of providing a complete and united system of electric traction all over London.

ON the Central Argentine Railway it has been found that by constantly changing the water supplied to the locomotive boilers, the scale formed on the plates is loosened. The company takes advantage of this and experiences no serious trouble, although their feed-waters vary considerably, showing 6 to 30 grains per gallon of scale-forming matters.

IT is officially stated that the West Coast companies will from December 1st accelerate the 10 a.m. train from Euston to reach Edinburgh (Princes-street) at 6.15 p.m. and Glasgow (Central) at 6.30 p.m., and that the 10 a.m. from Glasgow (Central) and 10.15 a.m. from Edinburgh (Princes-street) will be accelerated to reach Euston Station at 6.30 p.m.

THE Great Eastern Railway Company intends to apply to Parliament next session for extension of time to complete the St. Ives to Huntingdon Railway, and widening and improvement of the company's Felixstowe railway, and of railways Nos. 1 and 2 authorised by the Great Eastern Railway (General Powers) Act, 1897, and of widening and improvement of the Ware and Hertford branch.

AT a meeting of the Amalgamated Society of Railway Servants held on Sunday, to discuss the case of Mr. Unwin, who was recently dismissed from his employment by the Great Eastern Railway Company, speeches were made condemning the action of the company in dismissing a man who had been elected on a public body, and calling for the re-instatement of Mr. Unwin in his post as signalman.

STEPS are being taken by the Skegness Urban Council with a view to induce the Midland Railway Company to connect Skegness with Lincoln, to which the system extends. The route proposed to be taken is from Skegness to Burgh, Spilsby, Horncastle, to Lincoln, there connecting with the Midland Railway, and on to Nottingham. The route is about 39 miles in extent, the cost of one scheme is £670,000, and a second scheme £300,000.

A PECULIARITY in connection with the incrustation of locomotive boilers has been noticed on the Great Western Railway. Analyses of scale taken from the fire-box crown and from the feed-pipe show a remarkable divergence. The scale from the fire-box crown contains nearly 49 per cent. of calcium sulphate, and 26 per cent. of calcium carbonate, whilst that taken from feed-pipe contains only 2 per cent. of calcium sulphate, and 85 per cent. of calcium carbonate.

THE Pressed Steel Car Company, of Pittsburgh, is said to have received an order for 167 cars of 60,000 lb. capacity each, for use in South Africa. They are of a new type for South Africa, and will be used by several large gold mining companies for carrying coal to the gold mines. *Commercial Intelligence* presumes that this is the order which Wernher, Beit, and Co., placed in the States some few weeks ago. If so, it is interesting to know that the price is £40,000.

WE learn from an Indian engineering paper that good progress is being made with the Simla-Kalka Railway. Detailed surveys are completed up to the fortieth mile from Kalka, those up to Jutogh will be completed by December, and those to the Simla terminus by February. The work on the tunnels is proceeding steadily, and it is expected that construction trains will be run through to Dagshai this time next year. The line should be fully complete up to Tara Devi Gap, near Simla, by June, 1902.

AN article appears in last week's *Nature* on electric traction troubles, in which the writer calls attention to the damage which the Central London Railway is likely to inflict on the gas and water pipes in its neighbourhood by stray return currents of electricity. He estimates that if 10 per cent. of the return current strays from the uninsulated rails to the outside of the tube and comes back by the iron gas or water pipes, ¾lb. of metal will be removed from the latter in the neighbourhood of a sub-station in an hour.

THE Secretary of State for Foreign Affairs has received a despatch from her Majesty's Consul at Amsterdam stating that tenders are invited by the Dutch Government, to be received not later than December 19th, for the supply of materials for rolling stock for the Java State Railways; also for the metal superstructure for two suspension bridges for ordinary roads in the Netherlands East Indies. Such particulars as have been received may be examined at the Commercial Department of the Foreign-office.

IN the early hours of Wednesday morning a collision occurred on the Lancashire and Yorkshire Railway near Brighouse, which fortunately was unattended by loss of life, but caused considerable delay and damage to rolling stock. It was brought about by the breaking of the couplings of a goods train, thereby leaving several trucks and the guard's van in the rear. A mail train proceeding on the same rails later collided with the loose wagons, reducing them to matchwood. The engine and tender of the mail train left the rails and the first coach was wrecked.

ON Wednesday morning an accident causing considerable delay to traffic occurred on the gradient south of Lancaster Station. Some goods wagons were being shunted across the main line, and for this purpose a through goods train was signalled to stop. The driver of the latter train, however, was unable to bring his train to a standstill, owing to the slippery nature of the rails. The result was that the engine of the goods train dashed into the shunting wagons. The goods engine and six wagons of the shunting train were derailed. Both the up and down main lines were blocked, and the passenger traffic to the south had to be worked on the loop line.

NOTES AND MEMORANDA.

THE velocity of light has recently been re-determined by M. Perrotin, who gave some particulars of the experiments at a meeting of the Paris Academy of Sciences. Fizeau's method was adopted, the distance between the two stations being nearly 12 kiloms. The mean result of 1500 observations was 299,900 kiloms. per second.

AN extensive coalfield is said to have been recently discovered in the Hungarian mountain region known as the Banat. This new coal district is 52 kiloms. long and 8 kiloms. wide. The borings which have been carried out prove that millions of tons of coal can be worked. The coal is of an anthracitic quality. About three square miles of the coalfield is in German hands.

DURING the month of November there have been ten vessels launched at Sunderland, representing 32,207 gross tonnage. This brings the total for the eleven months of this year up to 65 vessels of 226,982 tons. In the corresponding month of last year only five vessels of 17,370 tons were put into the water, and the total for the eleven months was 66 vessels of 213,251 tons.

ACCORDING to the trade statistics of Natal for the last nine months, there is a satisfactory increase in revenue, viz., £563,602, as against £455,004 for the same period of 1899. The war has had the expected effect on the exports, in which there has been a decline of £2,174,256, or 80 per cent. The great pecuniary drain on Natal's revenues is shown in the Colonial Treasurer's returns, which show a balance of only £144,201, being £418,058 less than in 1899.

THE report of the Director-General of Italian Mercantile Marine has been issued. On December 31st, 1899, the merchant shipping represented 6074 vessels with 873,054 net tons. Of this total, by far the greater proportion was sailing tonnage, viz., 558,224 tons, represented by 5665 ships. Of steamers, the number was 409, with a tonnage of 314,830. Compared with December 31st, 1898, there was a decrease of 74 vessels, but the tonnage was higher by 57,892 tons.

THE steam trials of the new battleship Implacable, now completing at Devonport, have been deferred until the new year. The interior fittings of the vessel are practically completed, the guns are all in their places, and the machinery is in position. As far as the engines are concerned the trials could take place at once. The delay is in consequence of the mountings of the four 12in. wire guns not having been yet fixed, and this work will, it is anticipated, take about three weeks to complete.

A COMPANY with a capital of £1,000,000 has been formed in America to manufacture paper from the waste hulls of cotton seed, large quantities of which are piled up all over the south of the United States, constituting the refuse of cotton-seed oil mills. The company is said to control a new process for manufacturing from this material a new pulp which will keep white and never turn yellow as wood pulp does. Moreover, it only costs £5 per ton, whereas wood pulp costs £15 per ton.

THE value of exports of all kinds from Cape Colony, including raw gold, diamonds, and specie, for the first nine months of this year, is £5,280,135, as against £21,255,925 for the corresponding period of 1899. The large decrease of £15,975,790, or say roughly 75 per cent., is, of course, mainly accounted for by the decrease in the exports of Transvaal raw gold through the stoppage of work at the Rand mines by the war. The export of diamonds for the nine months amount in value to £1,971,362, and show a decrease to the extent of £1,835,283.

LAST year the value of Italian export to Germany was 236 million lire, while the value of German import to Italy was 194 million lire. Compared to 1898, the value of German import to Italy shows an increase of 37 million lire, while the value of Italian export rose 44 million lire. Italian export trade to England appears to have been even more animated—448 million lire—and the value of English exports to Italy was 484 million lire. In 1894 the value of business done between Italy and Germany was 282 million lire only, or 91 million lire less than the trade between England and Italy.

JAPAN stands tenth in the list of maritime nations. She occupies this position by virtue of her aggregate steam and sailing fleets, when compared with the combined fleets of other nations. At the end of last year the Japanese flag covered 471 ocean steamers, measuring altogether 484,000 registered tons, so that, in this respect, only England, Germany, the United States, and France, stand before her. Of these 471 steamships, 126, measuring about 260,000 tons, were owned by three companies, which are carrying on a hot competition with the other maritime nations of both Europe and America.

A TEST of a model of a partially submerged torpedo boat on the Berger system was made in the model tank at the Washington Navy-yard lately. The vessel is a combination of some of the features of the submarine boats and ordinary torpedo craft. All the vitals are below the water-line and the small surface of the vessel showing above the water is protected by cellulose, which expands on contact with liquids and stops leaks. The test was very favourable to the invention, the only objectionable features being the low speed developed, 14 knots, and a very perceptible wake. It is claimed that the vessel can be seen only at close quarters.

THE estimates for the United States Navy for the fiscal year ending June 30th, 1902, amount to £16,400,000. The estimate for the previous year was only £13,026,000. The increase is chiefly due to the necessity of continuing work on projects already authorised and started, as the new items in the estimates only aggregate £185,000. The largest single item is £1,338,000 for improvements at nearly all the navy yards and stations; £171,280 is for improvements at naval magazines and places under the Bureau of Ordnance, the increase of the navy calls for £4,354,000 for construction and machinery, £800,000 is for armour and guns, and £80,000 is for equipment. These estimates do not include vessels which Congress will be asked to authorise.

GERMAN fire insurance companies are said to have suffered severe losses owing to the large number of fires which have been caused by faulty electric light installations, and are endeavouring to induce the Government to make a law compelling the constant supervision of electric installations for lighting and power transmission. Prominence is being given to this question owing to the action of the Strassburg police authorities, who have issued an edict forbidding the use of any illuminant, other than electric light, for the "Waarenhäuser." This measure has been followed by the publication of the statistics of fires caused by electricity. These show that eight of the most serious fires in "Waarenhäuser" have either been caused, or are strongly suspected to have been caused, by electricity.

A NEW process for rolling rails is in use at the Edgar Thomson Steel Works at Braddock, Pennsylvania, by which the rails are rolled at a lower temperature than formerly, when the blooms were sent to the rail mill and rolled at a white heat. Almost as soon as they were placed on the hot beds they were sent to the presses, and straightened while at a high temperature. As they were rolled and straightened while very hot, the rails expanded again before cooling off, and much of the toughness of the fibre which they should have possessed was lost. It is found that with the new process the tensile strength of each piece is much greater than under the old system. The new process is simple, and consists in "breaking down" blooms while at a cherry-red heat, and then sending them into the rail mill and the press. The rails for the Pennsylvania Railroad Company are to be made by the improved process.

MISCELLANEA.

THE Castle Union line has placed orders with Barclay, Curle, and Co., of Glasgow, for four cargo steamers of considerable tonnage and high speed for the South African trade. The vessels are to be delivered within twelve months.

ABOUT eighteen motor cars are at present in use in Stuttgart for street passenger traffic; they are not making much headway owing to the sharp competition of the electric trams and the hilly configuration of the ground. A few are also used for the conveyance of goods.

LAST Saturday, in compliance with the notices posted by the management of Penrhyn slate quarries, the workmen, numbering about 4000, removed their tools. The quarries are to be closed for an indefinite period. A number of the younger men have left Bethesda to seek work in the South Wales collieries.

THE Corporation of Bombay, says an Indian paper, have at last been roused to the danger which threatens the local water supply by the precarious condition of the main from the Vehar Lake to Tansa, and have at last sanctioned as a preliminary measure the replacement of 1½ mile of old pipes by 48in. steel pipes at a cost of Rs. 325,000.

THE Swiss imports last year in electrical machinery amounted to £100,000, of which Great Britain supplied only £2000. Business in this branch was very brisk throughout the year, and has continued so during 1900; prices advanced about 10 per cent. The increased demand for Swiss electrical machines was mainly from France, Russia, and Spain.

THE battleship Glory left Portsmouth on Saturday for the China station, where she will relieve the Centurion. Before leaving Portsmouth the Glory was fitted with wireless telegraphy apparatus, and by this means she maintained communication with the Hector, the school of wireless telegraphy at Portsmouth, until she was fifty miles from the port.

ON the 16th January, 1901, the *Dundee Advertiser* will commence the second century of its publication, and the proprietors are anticipating the occasion by the publication of an interesting centenary number on December 4th next. This number, of which we have received an advanced specimen, is particularly interesting as showing the advance made in the production of a newspaper during the last century.

THE United States monitor Arkansas was launched at Newport News on November 10th. This is the first of the three new monitor vessels to be used as harbour defenders. She has a single balanced turret on the centre-line forward, protected by 9in. of steel, and intended to carry two of the new 12in. rifles in addition to four 4in. rapid-firing guns and three 6-pounder and four 1-pounder guns arranged on the upper deck.

AT the meeting of the Tramways Committee of the Manchester Corporation held on Tuesday, it was reported that Mr. Horace F. Parshall, had been appointed electrical adviser, and it is understood that Mr. Parshall's duties will comprise the general oversight of the work on the three tram routes now being re-laid, the planning of the Stuart-street Station, and a general control of the stations in Dickinson-street and Bloom-street.

THE cruiser Encounter, which is to be built at Devonport Dockyard, will be laid down next week, and in order that the early stages of her construction may be advanced as rapidly as possible, it is proposed to transfer to her a large number of shipwrights and skilled labourers now employed on the battleship Montague. Nearly a thousand tons of materials for the new cruiser have already been delivered, and a large portion of this is ready for fixing into position as soon as the keel is raised.

THE secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board have just been informed by their chartered accountant that the average realised net price at works for September and October is £8 11s. 4·49d. per ton. The effect of this will be a reduction of 5 per cent. in the wages of the workmen, dating from Monday, 26th November. This is the first time examination of the books has resulted in a reduction in wages being declared since the beginning of the industrial boom in 1895, while, on the other hand, successive advances have been declared during the interval amounting in all to about 40 per cent.

THE transformation which will ultimately result in utilising the Britannia Rapids, near Ottawa, for commercial and manufacturing purposes, is progressing rapidly. The Metropolitan Electrical Company, of Ottawa, began operations there early last spring with a modern and complete plant. There are five steam drills, three steam derricks, a steam dredge, two locomotives, and fifty flat cars, comprising part of the plant, and with these facilities the large force of men is making great headway on the big rock cutting. The total length of the canal is about 3000ft., but only about 1200ft. of this is solid rock, through which there is a cutting of about 150ft. wide, and varying in depth from 8ft. to 14ft. In the blasting of this rock about one ton of dynamite is used per day.

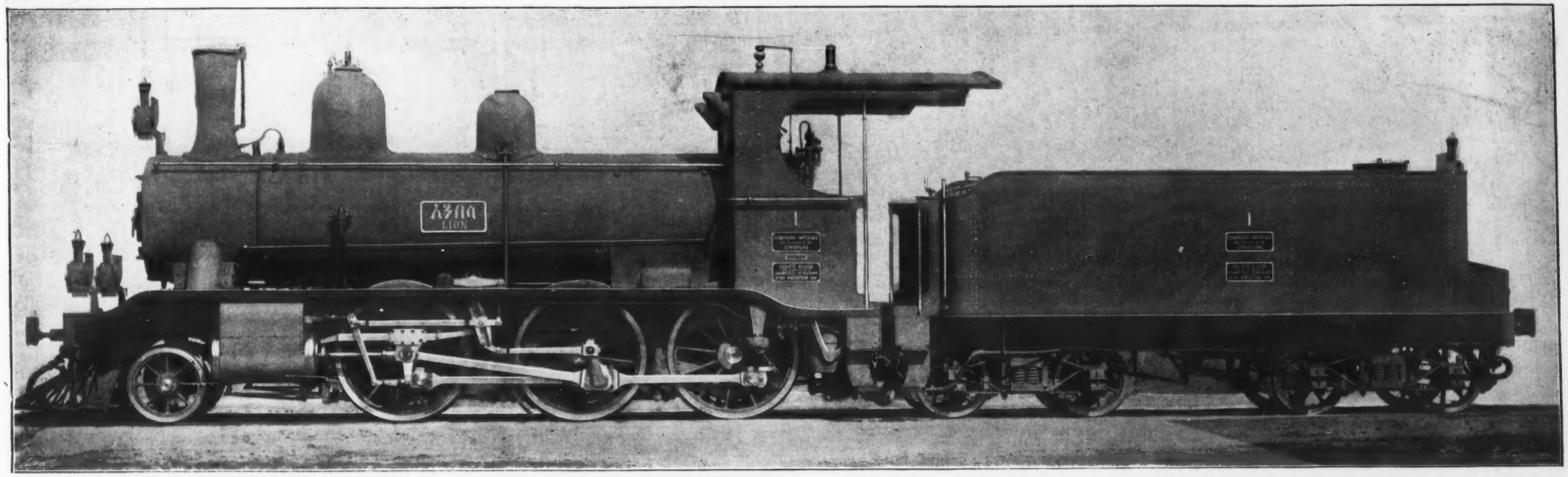
A CASE of some importance to the users of telephones was decided at the Banbury County-court on Monday, when the National Telephone Company sued two subscribers—hotel keepers—for £8 each, being the rent of telephones held under an agreement. The defence was that the defendants did not get a proper service. One defendant said that at Leamington he had waited thirty-three minutes, and was then told he could not be connected with his place at Banbury. Both he and his customers had never been able to get any reply from Leamington, and only once had he been able to get through to Wolverhampton. He had offered the company £5 to take the instrument away. The Deputy Judge said he did not think the company had carried out their contract, and had not fulfilled its conditions with regard to the use of the trunk lines, which was an inducement held out to subscribers. He gave a verdict for the defendants, with costs.

AN expedition of a private character despatched from Norway last summer to Spitzbergen to exploit the coalfields there, has returned to Throndhjem with good results. In Advent Bay large coalfields were discovered and seized, and some 500 hectolitres brought home as a sample. The coals, which are said to resemble anthracite, are reported by experts to be of good quality. A company is in course of formation in Throndhjem in order to work these coalfields. In addition, a cargo of coals has been brought from the well-known deposit at Cape Boheman, and they have been tried on the State railways and otherwise. The drawback to these coals is, however, that they leave a very large quantity of porous slag in the furnaces, and are quite unsuitable for locomotives. The slag, or deposit, of scoria would also prevent the use of the coals for domestic and factory purposes. However, the sorting of the coals on the spot might remove this drawback.

WITH regard to the Royal Commission which is investigating the administration of the Port of London, *Fairplay* is of opinion that as regards the alleged deficiency of depth of water in the navigable channel of the Thames, the matter has been much exaggerated. There may possibly be some half dozen or so of abnormally large steamers using the river which may occasionally be temporarily delayed, but undoubtedly with their exception the channel suffices for the trade of the port as it is, and as it is likely to be. At any rate, no such general inconvenience has yet arisen as to justify the outlay of very many millions of money to create an improvement that would bring no benefit to the vast majority of the trade which would be taxed to pay for it. It is not absolutely indispensable that a steamer here and there drawing 30ft. should be able to come up the river at dead low water, because she has only to wait for a couple of hours flood, and she can certainly go to Tilbury.

PARIS EXHIBITION—COMPOUND AND SIMPLE LOCOMOTIVES

SOCIÉTÉ SUISSE, WINTERTHUR, ENGINEERS



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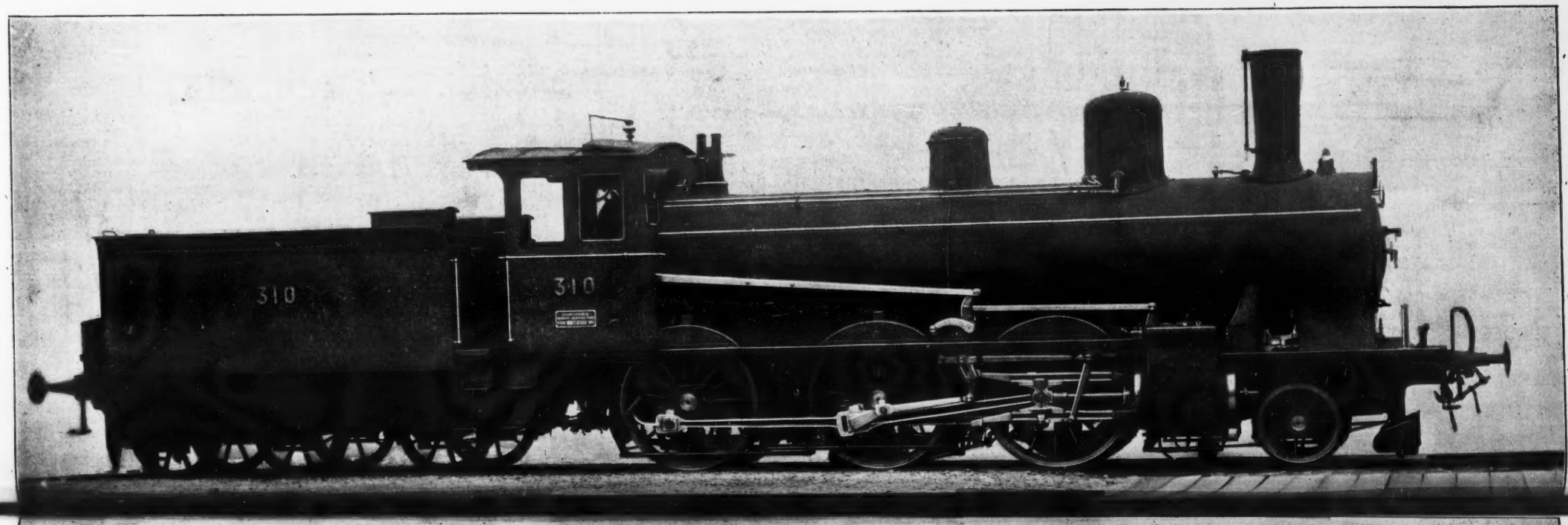
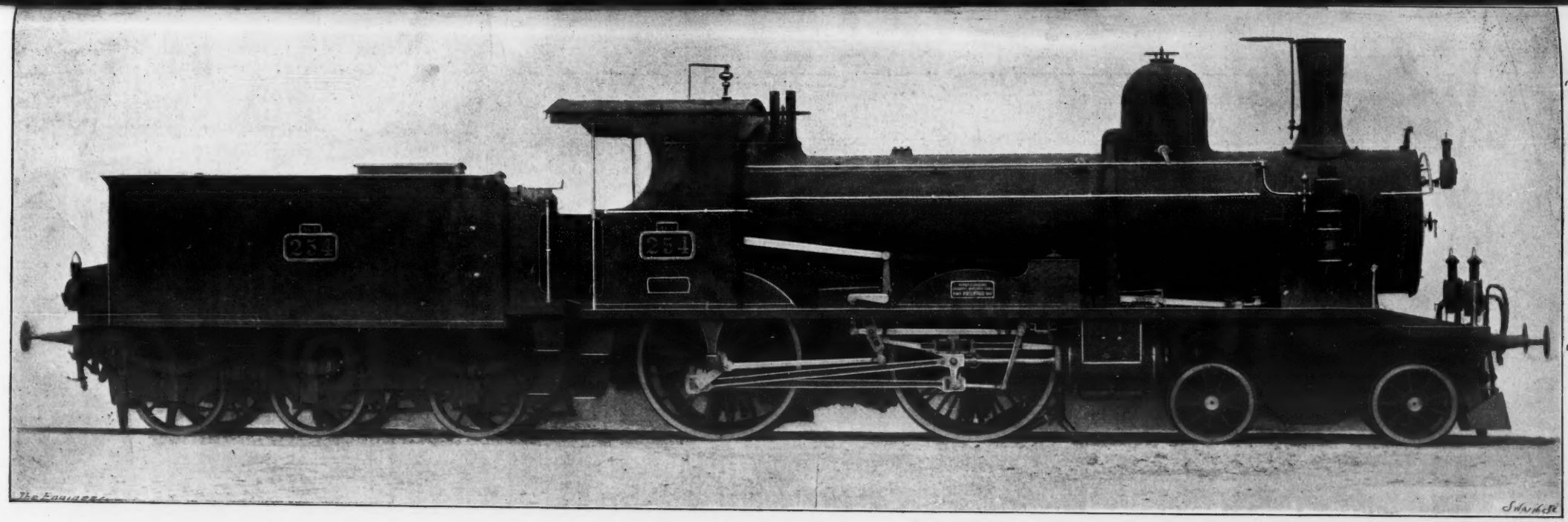
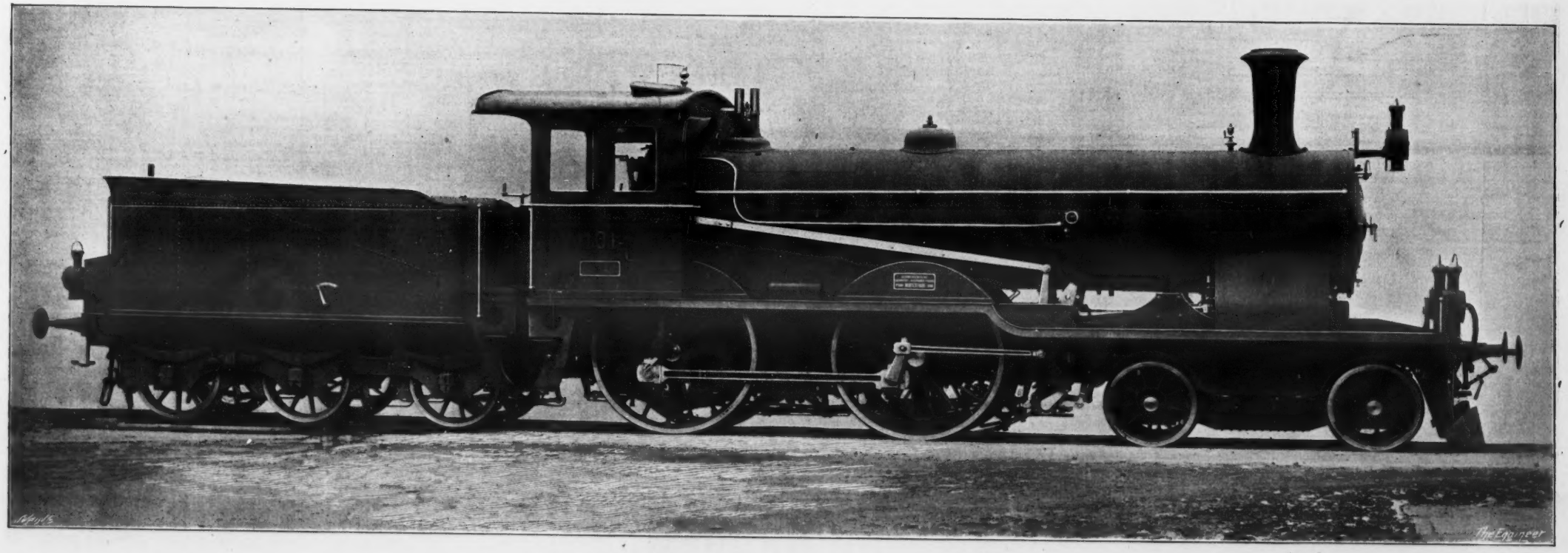




FOUR-CYLINDER COMPOUND ENGINE, CENTRAL RAILWAY OF SWITZERLAND



TWO-CYLINDER COMPOUND ENGINE, NORTHERN RAILWAY OF SWITZERLAND

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Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and, in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of The Engineer.

Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Engraving of Compound and Simple Locomotives. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

*** Latest Types of the British Fleet.—*Our two-page coloured supplement, representing H.M. ships Formidable, Drake, and Albatross, may be had, printed on superior paper, upon a roller, price* 1s., *by post* 1s. 1d.

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Two-page Supplement—Paris Exhibition, Compound and Simple Locomotives.

TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.*

REPLIES.

H. E. M.—The engine and profile of route were illustrated in our issue of August 26th, 1898.

S. V.—Try "Hand-book for Mechanical Engineers," by Henry Adams; you are sure to have it in your library. You will find useful combined formulæ in it. The subject is too long to deal with in this column.

Electric (Chelmsford).—Probably the best work on the subject which you can obtain in the first instance is "The A B C of Electricity," by W. H. Meadowcroft, published by Heywood's. This is, of course, elementary, but, judging from what you tell us, will be what you require. When you have read it, if you will write to us again, we shall be pleased to help you further by naming other books.

R. B. S. (York).—The details you ask for are given in "All the World's Fighting Ships," as follows:—(*a*) New French ships: 14,865 tons; armament, four 12in., eighteen 6¼in. (six in redoubt, twelve in pairs in turrets), twenty-six 3-pdrs., two machine; torpedo tubes, two submerged, three above water; armour same as Sulfrens, except that the 3in. deck will reinforce the belt, belt 12in., lower deck 5in., turrets 12in., redoubt 6in., small turrets 5in. One will be named Leon Gambetta, the other is not yet named. The other four are in the clouds as yet. (*b*) New German: A and B are the Kaiser Karl der Grosse and Kaiser Barbarossa. They have Krupp armour and are identical with the Kaiser Wilhelm II. Guns, four 10in., eighteen 6in., twelve 3·4in., eighteen small; armour, belt 12in., turrets 10in., supports 10in., deck 3in. (only curved aft), casemates and small turrets 6in. C, D, E have the same armour and armament, with a deck reinforcing the belt. C is now the Wittelsbach. The armour is differently disposed to the armour of the earlier ships—if you watch our pages you will find full descriptions and illustrations of her. Horse-power, earlier ships, 13,000 forced = 18 knots; later, 15,000 = 19 knots. (*c*) The New Bismark is the Prinz Heinrich, with which we dealt fully in a recent number of The Engineer. (*d*) The new second-rate Russian would be a sister to the Pobieda and Peresviet, but the idea of building her seems to have been abandoned in favour of a first-class ship. (*e*) Jurien de la Graviére; 5500 tons; indicated horse-power, 17,000 = 23 knots; three screws; guns, eight 6¼in., twelve 6-pdrs.; armour, deck, 3in. A species of unarmoured Desaix. (*f*) The new fifth-rate Russian is not yet named. Details as for Variag, &c. In reply to your second query:—(*a*) No details are yet to hand as to the projected first-class Austrian ships, and there is a good deal of uncertainty about them. Ships I. and II. (I. now named Habsburg) are 8300 tons; guns, three 9·4in., twelve 6in., twenty-four smaller; two submerged tubes; belt 8¾in., deck 2¾in., lower deck 4in., barbettes 8¼in., bulkheads 8in., casemates 6in. Probably the new ships will closely approximate to these. Habsburg, with indicated horse-power 11,000, is to make 18 knots; the new may be swifter. You will find full data in our "Dockyard Notes" so soon as anything is known. (*b*) The Knlaz Suvaroff is a sister to the Borodino, with which we are dealing at length. (*c*) The Encounter and Challenger, so far as we know, will merely duplicate the Hermes.

INQUIRIES.

PEAT FUEL-MAKING MACHINERY.

Sir,—Can any reader favour me with the address of German firms (1) making machinery for producing blocks from soft mud; (2) hot-air furnaces; (3) making peat fuel successfully?

Carlisle, November 24th. L. G.

MEETINGS NEXT WEEK.

The Röntgen Society.—Thursday, December 6th, at 8 p.m., at 20, Hanover-square. Ordinary General Meeting.

The Institute of Sanitary Engineers (Incorporated).—Wednesday, December 5th. General Purposes and Finance Committee at 3.30 p.m.; Election Committee at 5 p.m.

The Institution of Junior Engineers.—Saturday, December 8th, at 3 p.m., Visit the Electric Generating Station of the London United Tramways Company, 88, High-road, Chiswick.

Society of Engineers.—Monday, December 3rd, at 7.30 p.m., at the Royal United Service Institution, Whitehall. Paper, "Recent Practice in Sewage Disposal," by Mr. Henry C. H. Shenton.

Liverpool Engineering Society.—Wednesday, December 5th, at 8 p.m., at the Royal Institution, Colquitt-street. Paper, "Electric Driving of Workshops," by Mr. W. Arthur Ker, Assoc. M. Inst. C.E.

The Liverpool Self-propelled Traffic Association.—Monday, December 3rd, at 8 p.m., at the Royal Institution, Liverpool. Opening address by M. G. Forestier, Inspector-General of Roads and Bridges in France.

Society of Arts.—Tuesday, December 4th, at 8 p.m. Second Cantor Lecture on "Electric Oscillations and Electric Waves," by Prof. John A. Fleming, M.A., D.Sc., F.R.S.—Wednesday, December 5th, at 8 p.m. Ordinary Meeting. Paper, "Road Traction," by Prof. H. S. Hele-Shaw, LL.D., F.R.S.

The Institution of Civil Engineers.—Tuesday, December 4th, at 8 p.m. Paper to be discussed, "Machinery for the Manufacture of Smokeless Powder," by Mr. Oscar Guttmann, M. Inst. C.E. Papers to be read, "The Signalling on the Waterloo and City Railway," and "Note on the Signalling of Outlying Siding Connections," by Mr. Alfred Weeks Szlumper, M. Inst. C.E.; "Signalling on the Liverpool Overhead Railway," by Mr. Stephen Butler Cottrell, M. Inst. C.E.—Friday, December 7th, at 8 p.m. Students' meeting. Paper, "Dock Gates," by Mr. F. K. Peach, Stud. Inst. C.E.

THE ENGINEER.

NOVEMBER 30, 1900.

NAVAL ENGINEERS.

A fortnight ago we sketched a plan of reorganisation of the engineer branch of the service. It will be remembered that the principal feature of that plan was practically a reduction of the status of the naval engineer. He would no longer rank with the executive at sea, or aim at social equality with the deck officer on shore. His attainments would be those of the best and most competent sea-going engineers in the mercantile marine; no less and no more. To compensate him for his risks, and the—in many respects—disagreeable conditions of service, such as three years' commissions abroad, he would have high pay, and the pensions would be good. He should have more control than is now possible of his firemen. That is to say, when he wanted them they could not be taken away to discharge other duties; and in various ways more thought would be taken for the machinery of the ship. We have put this scheme forward tentatively for discussion. Up to the present it has scarcely been criticised at all. Possibly, perhaps, it has been regarded as so audacious that no words can do justice to its enormity. In putting it forward we stated that there was an alternative scheme about which we should have something to say. In fulfilment of that promise we now proceed to set forth the general features of this second scheme. To go into details would be at once premature and difficult.

In brief, it means the supercession of the sailor altogether—not in practice, but in theory. At present the dominant idea in the Navy is that a man-of-war is a ship, and that her officers and crew are sailors. That idea governs the whole policy of the Admiralty. Its effects are far-reaching. It modifies the relations of all the classes and ranks of the men who constitute our naval fighting strength. It is essentially a survival from the past. Under the new system a man-of war would be a machine, and nothing else. A machine afloat, it is true, but none the less a machine. The dominant idea modifying the policy of the Admiralty and of the service would then be that the sailor had disappeared and the engineer had taken his place. Under these conditions the engineer branch of the service would be superior to the executive; or, more properly, the engineer would be the executive. Just as we have advanced arguments in favour of the first scheme, we can now adduce arguments in favour of the second, which is the exact antithesis of the first. The modern man-of-war is a gigantic structure of iron and steel, which depends for her existence and her utility on the engineer. The modern gun is an extremely beautiful and complex machine, with next to nothing in common with the smooth bore of Nelson's time. The same truth holds good of the torpedo. Sails have entirely disappeared. The mast is a signal tower, or a place of observation. The "nimble topmen" have gone below as stokers and greasers. The great guns are loaded and fired by machinery. From first to last the engineer is everywhere and everything in the man-of-war. There is still room for the fighting bluejacket or the marine. There is none for the sailor, who has become an anachronism. But, it may be urged, we must still have seamanship. What does the word mean? In Nelson's time it meant a great deal. It involved a great deal. The art of sailing a ship through tempest and calm represented a very high standard of acquired experience, natural good sense, and special knowledge. There is nothing at all like this needed in the present day. An engineer might learn to carry out all the evolutions of a fleet just as well as an admiral or a captain, and when it comes to fighting, we doubt if any admiral or captain could excel the engineer in knowledge of what a ship could or could not do. It will, no doubt, come with a certain jar to the naval officer to be told that the engineers could do all that he does; that an engineer might be a post-captain, or an admiral in command of a fleet. Yet we question that the naval officer could advance any strong argument to prove that these things are impossible, and very able engineers in all but the name have already been captains in the British navy.

A glance at recent history will do much to prove that the true character of a modern fighting ship is beginning to be realised among all the principal nations. We have only to compare the position of the naval engineer of to-day with his position forty years ago, to see that, although progress towards a complete appreciation of the situation has been slow, it has been none the less sure. Notwithstanding all the drawbacks of the position, the naval engineer is more in evidence than he has been yet, even in this country. In the United States we have an intensely mechanical people, building up a navy in the light of the experience of the rest of the world, and their Congress has taken the first steps to make the engineer the dominant factor. The engineer is the equal of the deck officer in the United States navy. The next step will be to throw the past overboard altogether, and make the engineer the superior of the deck officer. It is beyond all question that even at this moment there is nothing in the rules of the United States service to prevent an engineer from being the captain of a ship. That nothing of the kind has as yet taken place, or, perhaps, will take place for some time yet, is simply the result of naval inertia, and the force of popular opinion not yet reconciled to the idea. We have recorded Admiral Melville's statement that so far the whole plan has been a failure. The engineer comes on deck; the executive will not go below. We said that the scheme is bound to fail, and we have given some reasons why. But the principal reason is that the change has not been sufficiently thorough. Let the engineer be above the executive or line. The discipline of the ship would then secure the presence of engineers below, just as it now secures the presence of officers on deck, as a mere matter of course. The whole "inwardness" of the service would be changed, and that which is now distasteful would become honourable.

To carry out the plan fully in this country, however, a radical change would probably have to be made in the training and education of our officers. Years of study and training are now required to turn out what is deemed a satisfactory executive or line officer. Precisely the same statement holds good of the naval engineer. It seems to be impossible to combine the two educations as they now are. There is not time. The difficulty would have to be got over by dispensing altogether with much teaching that is of no practical value whatever at sea. This applies to both branches of the service. The new curriculum would have for its object the making of a man an efficient engineer, so far as his particular work in the Navy was concerned, and an efficient executive officer also, so far as his duties were concerned, that is to say, his training would be highly specialised. There would always be, as there are now, men who would pick out certain branches of duty and develop their powers of dealing with them. Thus, we might have the electrician, and the torpedo lieutenant, the navigating officer, and so on. Really nothing would be done to diminish naval efficiency, but rather to promote it. The species of training now given in the United States might be taken as a foundation or an example to guide us in formulating a new system.

Our readers have now two definite schemes before them for the improvement of engineering in the Royal

Navy. Neither the one nor the other is advanced by us. They are only alternative schemes, which are to be taken for what they are worth. Either appears to be a solution, deserving careful discussion, of a great difficulty. It is certain that matters cannot continue as they are now. The public are becoming restless and apprehensive. Dissatisfaction is being expressed in every direction with the Admiralty, with our ships, with our machinery. Very strong action was taken in Parliament last session. Our readers may rest certain that the agitation will be renewed next year. Unpleasant questions are being asked concerning the competence of those who are in charge of the machinery of our ships. It is urged that the engines, at all events, main and auxiliary, are built by the best engineers in the world, and yet that they are incessantly breaking down under very moderate tests, and it begins to be said that it is not the fault of the engines but of those in charge. Account will have to be taken of these things. The cases of the Europa, the Hermes, and the Highflyer demand careful investigation. There were grumbles about the Powerful and the Terrible —some ships do very well, others very badly. Why?

We are not sanguine enough to suppose that either of the schemes which have been sketched will receive attention at the Admiralty. Yet we think it will be difficult for the Government of this country to ignore altogether in debate the remarkable action taken by the United States. The change, whether it succeeds or not, at all events represents the heaviest blow ever struck at the dominance of the executive branch of the service, and we may yet live to see the United States navy commanded by engineer officers. "Straws thrown up show what way the wind blows." It is not for nothing that Sir John Durston, in this country, has been given the relative rank of Rear-Admiral, and George Melville in the United States, the rank of Rear-Admiral.

THE LONDON STREETS.

At the present moment it is a matter of very considerable difficulty to get from one part of the City of London to another within any reasonable time either on foot or in a vehicle. Exasperating blocks in the traffic are of constant occurrence. One of the chief reasons for this is that hardly a week passes without one or other of the principal streets being picked up and pulled to pieces for some purpose. Water supply or hydraulic power pipes, telegraphs, electric light or telephone mains, &c., are constantly being interred and dug up again. There are other reasons, but for the moment we will confine our remarks solely to this cause. The population of London has increased out of all proportion to the extent the streets have been widened. An increase during a century of from under one million to six millions is phenomenal. With the population the general traffic has increased also as a natural consequence. The ordinary traffic of the City is too dense, even under the most favourable conditions, to ensure that there will be no delays at all. But the delay and inconvenience are many times greater when the streets are dug up in every direction. They are in this condition now; it is the exception, rather than the rule, to find a principal street entirely unblocked. No sooner is the excavation for one purpose finished than the surface is again torn up for something else. The matter is of great importance. The breaking open of the streets in the promiscuous and continuous manner which now prevails annuls any improvement in the direction of widening the streets which may be undertaken. It will be remembered that Sir John Wolfe Barry, in his address to the Society of Arts last year, estimated that, under ordinary conditions, the loss of time at some of the principal street crossings in London represented over £2,000,000. It requires little imagination to appreciate the fact that, with the streets themselves partially blocked, this loss is greatly increased. It is not once in a year, say, that the streets in the City are opened up. The process goes on incessantly. The excavations follow one another almost continuously. The narrowness or the crowded nature of a thoroughfare is no safeguard against its being attacked. Moreover, there is no apparent effort on the part of the authorities towards concentration. Surely, for example, when two sets of cables or conduits have to be laid down the length of a street it might be arranged by means of a larger trench or otherwise, to make one excavation serve for both. Had this been done, Fleet-street, which recently was opened up throughout by the Charing Cross and Strand Electric Lighting Company, would not now be rendered almost impassable by the trench for the Post-office telephones. But it is useless to go on enumerating examples. There is no doubt whatever about the fact that the continual breaking up of the roads is a cause not only of great inconvenience but also serious loss of money.

For this evil there is no evident remedy but subways. We have repeatedly drawn attention to their advantages. Under some of our streets there are already subways, and these streets feel the benefit. From near the Mansion House, along Queen Victoria-street, and throughout the Embankment to Westminster stretches a tunnel which is nearly full of pipes and wires of various kinds. The result is that the road is not picked up on every possible occasion. It is, of course, expensive in first cost to construct subways, and possibly the traffic might be interfered with while the work of construction was going on, although this might be obviated. The money, however, would be well spent and the subways to a certain extent would be self-supporting, for charges would be made for permission to run pipes or wires in them. If the work were well and thoroughly done and the subways made sufficiently large they would be of lasting benefit to our metropolis. The new street from the Strand to Holborn will be a good subject to which to apply the plan. The subways we would suggest should be large enough to take all the pipes, wires, &c., which it would at any time be necessary to lay down. There should be means of approaching them at intervals, and through these any connection to pipes or wires might be made. This would reduce the breaking up of the road surfaces to a minimum, and would confine what might be needed at rare intervals, to very small areas. That some such plan must be ultimately adopted in the old streets as it is being done in the new, if the use of underground pipes and wires is still to obtain, there can be little doubt. That it should be done in the first place instead of when roads are completed is, of course, obvious.

It might, perhaps, be argued that the cost of making subways under such thoroughfares as the Strand and Fleet-street would be prohibitive; that a section of such streets would show an immense collection of pipes and wires, and to move all these would be impossible. In addition to this it might be said that the various things already in the ground would probably necessitate the subway being deep, which would have the result of increasing its cost on account, if of no other thing, of the extra cost of the entrances to the tunnel for the roadway. Granting for a moment that it would not be practicable to construct subways under some of the existing streets, is it still necessary that the main and busiest streets should continually be more than half blocked? Naturally enough, those who wish to run wires take the nearest and most direct way to the point they wish to reach. This nearly always happens to be along the route which traffic has also found to be the best and easiest—in fact, along the most important thoroughfares. The layers of the wires do not care what inconvenience is caused as long as they can effect their ends in the cheapest manner, *i.e.*, by following the shortest route. In our opinion, in the case of the great main thoroughfares of London, the street surfaces should not be touched at all, and no blockage should be permitted save for purposes of repair. This would only be necessary at long intervals. We think that it should be prohibited to take up the road for other purposes, and that all future mains and pipes should be conducted so far as is possible through by-streets. The by-streets would suffer, of course; so would the persons who wished to take up the streets. It is fully recognised now-a-days, however, that the welfare of the majority must be considered before that of the minority, and this being so, it is perfectly clear that the main streets must be left as free as possible. It would not be such a great hardship, after all, for the pipe and cable layers. The by-streets of London are tortuous and narrow, but between any two places the way they take is not very much longer than the wider and busier road. The suggestion that these by-streets should be used does not, of course, mean that the whole question would be solved. It would be found, however, that there would be a material improvement, and, whether subways are to be made or not, it appears to be the most reasonable and feasible suggestion which has been made. Something must be done, that is evident, and we certainly recommend that, failing subways or until they come, trial should be given to this proposal.

AMERICAN ARMOUR PLATE.

The American Government has at last come to terms with the manufacturers of armour plate, and has scored a partial victory over them. The details of the dispute have already been given in these columns, but it may be permitted us to remind the reader that in August last bids were put in by three companies—the Carnegie and Bethlehem—which each tendered for one-half of the work offered, and the Midvale, which tendered for the whole, at a price appreciably lower than the others, though it could not furnish Kruppised armour, and asked a longer time for full delivery. None of the tenders seemed reasonable to the Secretary of the Navy, and that gentleman rejected them all, and threatened to take advantage of the powers conferred upon him by Congress, and to establish Government works for the manufacture of armour plate. The Midvale had in the meantime withdrawn its offers, presumably by arrangement with the Carnegie and Bethlehem people; but when the latter found Mr. Long determined not to pay 490 dols. per ton for armour of Class A, they became more tractable, and after conferences with Mr. Long satisfactory concessions were made. The Navy Department in turn has decided to dispense with about 5000 tons of the most expensive armour, substituting therefor about the same amount of lower quality. This was found practicable without materially reducing the impregnability of the ships for whose protection the armour is required. Instead of 30,000 tons of Class A (Kruppised) armour at 490 dols. a ton—inclusive of a royalty of 45 dols. a ton—7600 tons of Class B (Harveyised) at 411.20 dols., and 2300 tons of Class 3 (not hardened), at 400 dols., involving an outlay with bolts and nuts of 20,125,120 dols., contracts have been given out for 24,950 tons of the first at 455.52 dols., for 10,250 tons of the second at 411.20 dols., and for 1610 tons of the third at 400 dols., involving an expenditure of 16,405,024 dols. No order for bolts and nuts for fastening the plates to the hulls has been given out, and this item accounts for 480,000 dols. of the total saving of nearly 4,000,000 dols. Instead of paying for these at the rate of 400 dols. a ton now, when they will not be needed for at least another year, the Department has decided to wait, in the expectation that it will be able to purchase them without difficulty in the open market at any time for less than 300 dols. a ton. In the new contract the Government has the advantage of certain legal contingencies, which, it is barely possible, may result in an additional saving. This depends upon the outcome of suits now on trial testing the validity of the Harvey patents. If the patents are set aside, the Navy Department will be relieved from paying the royalty on every ton of Harveyised and Kruppised armour it buys, the Harveyising entering the plates before they are submitted to the Krupp process. The contract price for Class A armour is actually 420 dols. a ton. But as the Krupp process involves the Harvey patent, the validity of which is now under consideration, the Government will assume any liability for the Krupp process not exceeding £5 or 24.32 dols. a ton for Krupp royalty, and not exceeding the United States licence fee of 11.20 dols. for the Harvey royalty. The maximum price to the Government is therefore 455.52 dols. a ton, subject to diminution in case of any reduction in the foregoing royalties. For the time being, the armour-plate controversy has been laid, but we have no doubt it will emerge later on. It has been carried on ever since the first award of a contract in 1887, sometimes with great heat and with indulgence in very strong charges against the Corporations that were filling orders for armour. The discussion has occupied successive Secretaries of the Navy since Mr. Whitney, and has produced a vast quantity of documentary testimony as to the value of armour, of processes for hardening it, its cost, the profits of manufacturers, the feasibility and advisability of Government production of the plate in competition with private makers, and the alleged discrimination of armour-plate makers in the United States in favour of foreign purchasers and against the Government that had contributed by high prices to the establishment of plants in the United States. It is fair to assume that the action of the Senate and House in the last session of Congress in empowering the Secretary of the Navy to spend 4,000,000 dols. on the erection of a Government plant has had something to do with the decision of the Carnegie and Bethlehem companies to accept a price very much below what they had originally demanded. That these great companies have made this price, even under the constraint of the Congressional threat to run them out of the business, is presumptive evidence that they can afford to provide armour at 420 dols. a ton. They are not in business just to prove how they can be patriotic at a loss to themselves.

THE PROPOSED NEW GERMAN TREATY.

Some misunderstanding seems to prevail about the proposed new German tariff. The Sheffield Chamber of Commerce brought the matter before the Foreign-office, and on receiving a reply, decided to take no "direct action" in the matter, but to keep a "watchful eye" on the business. The Foreign-office reply was that "there would be no negotiations for a new treaty of commerce between Germany and this country until 1903." It was stated by one of the members, who is usually well informed on such questions, that the German treaty would not expire until 1903. There must be some error here. As a matter of fact, the commercial treaty with England expired in July, 1899, and this country is at present working under a provisional treaty, expiring on June 1st, 1901. While the British manufacturers, if Sheffield is to be regarded as a sample, do not seem disposed to move in the matter at present, the Germans are not quite content to take things so easily. There are two directly antagonistic interests in Germany. The great steel manufacturers, represented by such important firms as Krupp, whom the Germans class under the term of "Agrarians," want customs rates which will prohibit British and other foreign manufacturers. The consumers of steel, on the other hand, desire to have what they need from Sheffield or elsewhere as before, and these consumers have formed themselves into an association for the purpose of maintaining the present customs policy. Dr. Von Siemens, director of the German Bank, spoke at the meeting at which the association was formed, and stated that its duty would be to combat the exaggerated claims of the Agrarians to have practically prohibitive customs rates. It does not appear at all certain whether the Reichstag will discuss the question of the new tariff during the coming session of 1900-1901. The latest information points to the probability of its not being brought forward until the session of 1902-1903, as the commercial treaties with other Powers besides Great Britain do not expire until 1903. That is perhaps the reason of the misunderstanding in British commercial circles, where it does not seem to be realised that the German treaty with England has already expired, and has only been provisionally extended until June of next year. It may be interesting in view of the proposed prohibitive tariff to point out that the Germans, if subjected to a similar policy on the part of England, have a great deal more to lose than we have. The Germans do a large business with England in wire nails, rails, ironware, finished hardware, and rough hardware. In 1899 we sent to Germany 2439 tons of ironware, representing a value of £4500; finished hardware to the value of £50,000; rough hardware, 7497 tons, value £285,000. Germany on the other hand, sent to us as follows: —Iron wire, 30,008 tons, value £245,000; finished hardware to the value of £325,000; rough hardware, 12,206 tons, value £490,000. In addition to this business, Germany sent us 13,258 tons of wire nails, value £115,000, and of rails 21,394 tons, value £130,000. In these two classes Great Britain did no trade whatever with Germany. The views of the German consumers, as received in Sheffield, are to the effect that the only way of defeating the German Protectionists in this grave menace against British trade, is to bring pressure to bear upon them from this side, by pointing out that England may be compelled to use the weapon which they have in their hands, and enter vigorously on that war of tariffs which Lord Salisbury said long ago would be "the wars of the future." If we treated Germany as Germany proposes to treat us, the German Agrarians would soon be on their knees. Compared with the trade Germany does with Great Britain and her Colonies, British trade with Germany is a mere flea-bite.

BRITISH RAILWAY ORDERS IN THE UNITED STATES.

Sir Howard Vincent has sent to the *Times* two letters of exceptional interest. Having heard a rumour that the Great Eastern Railway Company had placed an order for steel rails with an American firm, he wrote to Lord Claud Hamilton, the chairman of the company, asking if the report was correct, and, if so, what reasons led the Great Eastern directorate "to take a course apparently so prejudicial to British industry." Lord Claud Hamilton replies very frankly. "I am sorry to say," he writes, "the report is true—viz., that we have placed a large order for steel rails and fish-plates with Carnegie's Steel Company. Our reasons for taking such a course are the obligations we are under to maintain our road in a high state of efficiency, and thus to provide for the safety of the travelling public." Lord Claud Hamilton adds:— "We have had during the past two years two contracts running for rails and chairs with one of the leading rail com-

panies in England, and the final deliveries of the first contract were eleven months in arrear, whilst of the second we have not yet received a single rail, and it shows a deficiency of 9000 tons, and this in spite of the most strenuous and continuous exertions on our part to ensure punctuality in delivery. The consequence has been that our engineer has been seriously impeded in his work, and the necessary relaying of portions of our road has been unavoidably delayed. We had therefore no option but to go where we knew we could rely upon good material and prompt delivery, and that at a price below what we should have been compelled to pay in England." The company referred to is one of the largest and most enterprising in the country. On inquiries being made at its headquarters, it was considered undesirable to give any information in the absence of the chairman, who had that day gone to London. Possibly it may be found that the unfortunate placing of British railway orders with foreign rivals arise from several causes, including the sudden influx of orders from railway companies, who had withheld work of this kind until they could withhold it no longer; difficulties with the workpeople, and inability to obtain adequate supplies of materials and stores at the required time. It is only fair to the manufacturing company, which has a great reputation for other besides railway material, to withhold comment until we have its version of the business before us. The company, as a matter of fact, has for years done an enormous home and export trade in railway material, their rails being in special favour on American railroads, for which they have supplied very heavy weights.

DOCKYARD NOTES.

QUITE an interesting article might be penned on the Navy and Mr. Watts, of Elswick. But three or four years since the Navy implicitly believed what it was taught, that Elswick style of ships were merely pretty things on paper. Ships, like the Takasago, are known to be undesirable from the needs of the British Navy point of view. So long as Elswick built second-class cruisers only the anti-Watts doctrine was manfully adhered to, but the Asamas have changed all that. Elswick's most fervent disciple to-day is the British naval officer.

NAVAL officers are far from satisfied with the Cressy class—the ground of complaint being that six huge ports are cut in her armour each side. This considerably weakens the armour. Presumably it is the old ventilation fad, responsible for cutting holes in the casemates of the Diadem class and covering them again with a thin bit of brass. The Renown was the first ship in which this prank began. In her some armoured doors are non-existent, *for the benefit of ventilation*. Ventilation is a desirable thing, but men-of-war are not designed solely with a view to pretty systems of ventilation.

THE Invincible having had her guns removed, has gone back into the basin at Portsmouth. Apparently the authorities have some difficulty in screwing their determination to rid the Navy of such an obsolete "war junk" to the sticking point.

The Cressy is out doing trials, and got successfully through the preliminary run. She has now gone off Plymouth for more serious trials. It may be noted, *en passant*, that her barbette guns are not mounted. Whether or no she carries equivalent weights has not been stated.

The Norwegian Government have made a special grant for the purchase and installation of the Jane Naval War Game in the Norwegian fleet.

ORDERS have been received at Sheerness for the laying down of the usual sloop, twin-screw. If instead of laying down these useless craft the Admiralty would bestow the same energy in hurrying up good ships that are at present so far behind time it would be a good deal better for the country. The Navy League often takes up unfortunate positions, but everything that it has said about delayed ships is perfectly true. What is worse, we see no signs of any attempt to hurry things at all.

THE Russian ironclad Sevastopol left Brest for Cadiz on the 18th. The Poltava left Cherbourg on the 17th for Vigo. Both have now reached Spanish ports. The destroyers are still in French ports, the Skat and Kassalka having reached Cherbourg as long ago as the 14th. The Kit and Dolphin joined them there on the 19th. The Gromovoi appears to be still at Kronstadt or Libau. Owing to a slip we described last week the Pallas—or Pallada, as the Russians call her—as a first-class cruiser. We should have said first-*rate*—rate in Russia depends on the complement. The ship, of course, is in fighting value a second-class cruiser, about on a par with our Eclipse.

THE French ironclad Neptune will be reconstructed next year, and given Belleville boilers. Her engines are to be altered also. The work will occupy till 1902.

THE reconstruction of the Dévastation—French—is now in progress. Her upper works are all taken away at present, in order to get in her new boilers—Bellevilles. A cofferdam is being fitted on the lower deck. The new armament will, it is now stated, consist of four 10·8in. guns—latest model—in battery behind stout shields of hardened steel, two 9·6 guns—latest models—in barbettes, behind shields on the upper deck above the battery, and four 4in., two forward and two aft. The ten 4in. substituted for six 5·5in. some time ago will remain. The result is:—

Original armament.	*Suggested.*	*New armament.*
Four 12·6in. (old coast gun)	Eight 10·8in. (old model)	Four 10·8in. (m. 1893).
Four 10·8in. (mod. 1880)	Ten 4in. (m. 1892) ..	Two 9·4in. (m. 1893).
Six 5·5in. (mod. 1881) ..	.. ..	Fourteen 4in. (m. 1892).

The penetrations of the new heavy guns are far better than of the old, but the shells are, of course, smaller. There is a big difference in the rate of fire.

THE French armoured gunboats Cocyte and Phlégéton are to be sent to Saigon to join the Styx. Some doubts are expressed in France as to whether, on account of their unseaworthiness, they will not "cross the Styx," instead of joining the vessel of that name. Craft of this sort are not built for sea voyages. However, the Styx got out all right.

CONSEQUENT upon a change of admirals, both of the principal French fleets have been re-organised somewhat. The tactical composition is now:—Mediterranean: First division, St. Louis, Charlemagne, Gaulois; Second division, C. Martel, Jauréguiberry, Bouvet; First cruiser division, Pothuau, Latouche Treville, Chanzy; Second cruiser division, Cassard, Du Chayla; Third cruiser division, Linois, Galilée, Dunois; Torpedo flotilla, destroyers, Espagnole and Hallebarde; Torpedo boats, first class, three. Channel: First division, Massena (flag), Carnot, Baudin; Second division, Formidable, Duperré; Third division, Bouvines, Valmy, Tréhouart, Jémappes; First cruiser division, Bruix, Dupuy de Lôme, D'Assas; Second cruiser division, Infernale, Fleurus, La Hire; Torpedo craft, Cassini, and destroyers Durandal, Yatagan, and Fauconneau.

IT is worthy of note that in the Mediterranean fleet something like homogeneity in the divisions is arrived at. The first division are sisters, the second very much alike. There are only nine types all told. In the Channel fleet there are thirteen—not bad for a fleet of sixteen vessels. There are, by the way, no less than four admirals in this fleet. The system has disadvantages, but on the whole—seeing how over-plentiful admirals are—they are better employed afloat in unnecessary quantities than on half pay ashore, like so many of ours are. On shore they take to farming, or being company directors, in neither of which callings is the supply so far behind the demand that the country could not spare them afloat. It is cheaper, of course, to leave them ashore, but we question the goodness of the training. We have known so many smart commanders turn out most indifferent captains after the three or four years' potato growing that the necessary half pay always means. As soon as the farming mania is once more overcome by professional duties they are sent back again—unemployed admirals on half pay.

THE CYCLE SHOWS.

THE cycle shows this year are disappointing. The period of acute depression which the cycle trade has had to contend with during the last two or three years, and the severe competition which exists, have had the inevitable result of thinning down the number of exhibitors. Both at the Agricultural Hall, where the twenty-fourth exhibition, promoted by the Stanley Club, and at the Crystal Palace, where the ninth National Show are being held, there is a marked decrease in the space taken up by cycle makers. The motor-car builders are more in evidence than hitherto, it is true, and had it not been for the large increase in self-moving vehicles shown, all the cycle exhibits might have been easily covered by the roof of either building. Last year the shows were rendered more interesting than their immediate predecessors by the introduction of the "free-wheel" bicycle, which appears to have lived down the greater portion of the opposition with which it was met, and in some form or other is now to be seen on almost every stand. Cycle makers are wise enough to understand that if the rider has to be tempted to discard his past season's mount they must introduce some novel feature, however small, and there is ample evidence this year that they have had difficulty in devising the so-called "improvements." Anti-vibrating appliances have been resuscitated this year. Such devices were prominent at the Stanley Show many years ago, but the introduction of the pneumatic tire caused the manufacturers to divert their attention to wheels, as it was considered that the air-inflated tire would provide sufficient insulation from shocks due to uneven road surfaces. The desire for high speeds—once the besetting evil of the cyclist, as it appears at present to be of motor-car drivers—seems to have had its day, and has given way to the desire for ease and luxury. Manufacturers who used to devote all their attention to the reduction of weight are now no longer fettered in this direction, and are taxing their resources to devise all manner of modifications to ornament and give a luxurious appearance to their products. If not carried too far the tendency is in the right direction.

A NEW MOTOR BICYCLE

Another feature of the cycle industry of to-day is the motor craze. We cannot but regret this. The cycle is a means for exercise, and its chief function is removed by the addition of an engine. Moreover, the bicycle does not lend itself readily to the new adaptation. The Singer Cycle Company, Limited, have, however, made a departure in motor cycles, which commends itself above all others which have come to our notice. The engine, of the internal combustion type, using petroleum spirit, the carburetter, speed gearing and ignition device, are all contained in the driving wheel of the bicycle, or in the front wheel of the tricycle, and the arrangement is not nearly so unsightly as in most motor cycles. The motor is capable of developing about 2 horse-power; it is air cooled, and is provided with the Simms-Bosch magneto-electric ignition. The cycle wheel is composed of two aluminium cages, which run on ball bearings on either side of the motor, and are bolted together near the rim. The rim is of steel, and is fitted with a pneumatic tire. The crank shaft of the motor lies below the centre of the driving axle, and carries a spur wheel, which gears into an internal toothed wheel fixed to one of the aluminium cages. The relative speeds of motor and road wheel are as 7 to 1 approximately. Only one regulating lever is fitted, and this is on the handle-bar of the cycle. In one position this lever reduces the compression in the cylinder for starting, and in the opposite position it controls the explosive mixture. The machine only differs from an ordinary bicycle as regards the back wheel, the rear forks, and the increased width between the cranks; its weight is about 1 cwt. The carburetter is of special construction, and gives a constant mixture of air and vapour, thus dispensing with the regulating devices. Its design is such that the spirit will not spill if the machine is overturned, and as the explosions are caused by an electric spark, there is little danger of fire. This machine is the patent of Messrs. Perks and Birch, and is shown in the annexed illustration.

Reverting to cycles proper, we may briefly allude to one or two of the anti-vibrating devices which have not been previously described in these pages. The Flexible bicycle, exhibited by Mr. R. L. Philpot, has specially-constructed front forks made of flat strips of spring steel, which extend down from the front and back of the square fork crown till they meet, when one ceases. The other continues, and at its end supports the front wheel spindle. The unevenness of the road makes the wheel rise and fall, and the two strips of spring steel forming each fork blade move slightly relative to each other. The chain struts are replaced by similar flexible steel strips, and though they resist the pull of the chain, admit of a considerable rise and fall of the rear wheel. The seat stays are fitted with a stiff, coiled, flat spring to accommodate the movement allowed by the flexibility of the chain stays.

The Birmingham Small Arms Company is introducing an elastic-framed bicycle in which the vibration is absorbed by three coiled springs secreted in the tubes of the frame. Two of these are in the back stays immediately under the saddle, and one in the top tube of the frame. Telescopic tubes are fitted at these three points, and thus the springs are allowed to absorb the vibration from the road surface. Four knuckle joints give the necessary vertical play to the frame, two near the bracket and one at either end of the top tube. In neither of the above devices is the distance from the saddle to the pedal altered by the elasticity of the frame, but the knuckle joints in the frame of the B.S.A. machine are not desirable features. In rigid frames there is a tendency to discard the diamond form which has for so long been almost universal. The Referee Cycle Company is removing the top tube, which extends from the steering head to the seat pillar, and is substituting two cross tubes in the shape of one elongated horizontal letter X. Though not so neat as the older form, this arrangement gives rigidity to the machine and strengthens the bottom head lug. The various stresses to which the fore part of the frame is subjected are in this model concentrated at the cross lug, where the least harm is likely to result.

The Garrard optional free-wheel and brake device—of which a description appeared in THE ENGINEER of July last—has been modified somewhat, but the general features are the same. Bradbury and Company, Limited, Oldham, show a "free-wheel-at-will" apparatus. In this arrangement the free-wheel clutch of the ratchet type on the rear hub can be locked to allow of "back pedalling" by the movement of a lever fixed on the top tube of the frame. This lever has a steel flexible cord passing down the frame to the back hub wheel, and is fastened to a spring fork, which moves a sliding cap. The cap when drawn out allows the back wheel to run free, and when the lever is moved the spring fork moves the cap over the sliding pawls, and locks the wheel, converting it from a free-wheel into a fixed hub wheel. Lea and Francis, Limited show a clutch in which the friction is remarkably slight. When free-wheeling the bearing of the clutch, which is of the pawl-and-ratchet pattern, being mounted on the non-rotating axle, does not come into action, and the only parts in contact as between the stationary chain wheel and the hub ratchet are four small pawls. The friction thus caused is so slight that it will not drive the chain wheel, although this is mounted on a ball bearing. A further advantage claimed for this device is that the hub-bearing has not to perform the double duty of withstanding the pull of the chain in addition to carrying the weight of the rider and machine. The whole is simple of adjustment.

A self-inflating tire is shown at the Crystal Palace by the Self-Inflating Tire Company, Limited. Although not yet in a form suitable for putting on the market, the principle of the tire is easily demonstrated. It differs from other automatic inflaters, inasmuch as it involves the use of no mechanical apparatus. Briefly, it consists of an ordinary pneumatic tire, but the inner tube does not rest on the bed of the rim, as is usual. On the rim is a flat steel strip inserted in a pocket of the outer cover, which has a suitable contracting fastening by means of which the tire is held firmly on the rim. Lying on this strip is a flexible rubber tube enclosed in a canvas pocket, while above this is a flexible band upon which the tire tube proper rests. The flexible tube next the steel strip acts as a pump, being open to the atmosphere at one end, and at the other it communicates

with the tire tube through a suitable valve. As the wheel revolves the small tube is compressed, and a column of air is driven into the tire tube. The pressure to which the air is compressed can be regulated at will.

LETTERS TO THE EDITOR.

(We do not hold ourselves responsible for the opinions of our correspondents.)

NAVAL ENGINEERS.

Sir,—I think you have touched the right note in your leading article, "Naval Engineers." The way the Admiralty are educating the future engineers has and will ever defeat the object in view. Work in the engine-room is always practical, the whole of the theory is finished for ever when the machinery is once made, and any engineer on board has to do with things as they are, not as they might be. In the profession the more a man is educated the less he relishes dirty manual labour. The two never have been or ever will go together. A highly educated man, such as the Admiralty wish to turn out, is totally out of place in any engine-room; as you truly say, he is quite useless below. The chiefs of any of our mail boats are not men brought up at any school or college; but, as a rule, men that have worked their way up from the fitter's bench. A certain amount of education is necessary, of course, to pass the Board of Trade, but this, in nine cases out of ten, is acquired as he goes on, from the time he is third till he finally passes for his chief's ticket. Even this knowledge in after work as chief is of very little use to him at sea. Ask any chief how many times in his life the questions he had to answer at his examination served him at sea in the engine-room, and he will tell you very few; but the fact he has had to work up for them, of course, shows that he has the making of a man in him. Said knowledge is all, quite all, that is necessary for any sea-going engineer, whether he is chief of a liner or chief of the Terrible. The Navy man is fond of telling us that a man-of-war is a very different affair to a mail boat. In one we have a hull packed with machinery all of a special kind, which requires special knowledge; in the other a slow-running engine and few auxiliaries. This I will not admit. If you compare any of our liners with a warship, and take engine for engine, you will find not such a vast difference; but where the merchant ship's machinery is always working for what it is worth, the warship's is nine months out of the twelve at, perhaps, half power. Take a large twin-boat in the frozen meat trade from the Colonies. For forty or forty-five days, from one side of the world to the other, year in and year out, she must run, and the engineers have nothing near the number of men or the conveniences that a warship has. Show me a ship in the mercantile marine that has a workshop and the men of different trades that a warship has. In one case it is a makeshift; ratchet brace, a few clamps—as a rule made on board—a small lathe, this not always, that you have to do with. A warship's workshop is fitted with every convenience—practically an engineer's shop—regardless of cost. The truth is, the Navy man does not know he is well off; his living is secure, promotion practically certain, and a pension to boot. Compare this with his brother in the merchant service; less pay, the chances of trade, a single-slip, loss of berth, and finally, what when he is too old for service?

The class of men that would work our fleet to advantage, be satisfied with their position, and not expect to dance with the Admiral's daughter, are men whose whole educational acquirements are not more than are required for the Board of Trade. Where are the hundreds of foremen and charge-men drawn from that fit the machinery and run the trial trips of the many foreign and English men-of-war that have been built here and delivered all over the world—not only delivered, but kept up to date without Government dockyards? Were the chiefs of the Chilian and Chinese warships that fought in action college men? Certainly not; but good men from the mercantile marine. Do our private yards, when they have to deliver an ironclad, petition the Admiralty for a chief to take her out? No; one of their own men go, and the firm have that faith in him that they guarantee the machinery for a long time. I have been pretty well all over the world, sometimes chief of a merchant ship and sometimes guarantee for a warship, but I have yet to see one of the latter but what I would take charge of, and get out of her what she was worth, and my training was not a college one. Will the Admiralty put a chief out of the Navy on the Ophir, chartered to take the Duke of York out to Australia? I imagine the owners would have a word to say on this. That the Admiralty see something in this is evident, as they are putting artificer engineers, who are the backbone of our engine-rooms, in charge of destroyers, and these are pretty full of that special kind of machinery the Navy man is so fond of quoting; said artificer is not a college man, but is of the class our merchant marine are drawn from. I would stake my life that in the next naval war, if a ship had *all* her engineers killed in the middle of an action, the action would be finished and the ship brought to line, and the commander would know nothing about it; the artificers would stop and start engines and carry on routine by themselves. We often hear how the stokers are quite raw, and no man can get the speed out of a ship until the crew are used to her; but his stokers are sober, and under strict discipline. Compare these with the class of stokers we have to put up with in the merchant service, and the ship has to go, or else, on return of ship, the chief.

It would be curious to put a cruiser side by side with one of our liners, and, at a word, transfer the engine-room staff from one ship to another, and within an hour start for New York, and see if the liner would keep her time. But of this I am certain, the cruiser would. No, depend upon it, the service wants the purely mechanical man, who, if needs be, will work himself with the tools; this the highly-educated man never will—his very education is fatal to it. He knows his education has fitted him for better things, but there are not any better things on board ship, and so he will be a grumbler to the end of the chapter.

As to the social position. Well, on board of our mail boats—at least some—it is not universal; the chief can dine in the saloon with passengers or use the mess-room as it pleases him, and you may depend on it it works out right, or else the owners would alter it; and I suppose the passengers are of equal position to the officers met with in the ward-room of a warship—in fact, these very men, when returning home on a mail boat, mix and converse with the mercantile chief. One of my best friends is a naval officer, who was one of our passengers from the Pacific station.

Mercantile Chief.

Kingston-on-Thames, Surrey,
November 26th.

Sir,—It is with considerable diffidence that I undertake the responsibility of offering a reply to your correspondent "Fidley House," for he claims such a wide and deep knowledge of the Navy, its ships and its machinery, its officers, and their "manners and customs," that it is difficult to escape from the feeling of a sense of irreparable loss to the country, that "Fidley House" was not inducted to one of the recently-vacated seats at the Board of Admiralty. He is evidently a reformer of the root-and-branch type, and clearly sees his way to run our fleet without the aid of the thousand engineer officers whose names at present encumber the Navy list.

Your correspondent states that he has studied closely the numerous articles published about engineers in the Navy, and yet after all this study he is so ignorant that he even does not know the nature of the duties of that branch of the service, either at sea or in harbour. Less than two years ago The Engineer published the fullest details on this very subject, and afterwards very generously issued these articles as a small pamphlet. Let "Fidley House" procure this little book, and he will then possess the answer to one of his questions, for the information contained therein was contributed by a naval engineer.

Your correspondent is so very positive about the superior merits of the engine-room crew of an Atlantic liner, not only to carry out their own work, but also the duties that would be demanded of them if placed on board a battleship, that one cannot help regretting the impossibility of seeing the experiment tried. So far as steaming the vessel from Liverpool to New York is concerned, possibly there would be nothing to choose between the Navy and mercantile men; but this is not the purpose for which the Navy ships are built.

What can be simpler than the routine of a "liner"—light up all the boilers, to have steam ready at the required time, and then, when once clear of the harbour, every machine in the ship is set going at the speed that will be required of it until the vessel is made fast to a wharf at her destination? But these conditions, which are common to all mercantile steamships, are seldom met with in the Navy. Take a squadron that has orders to leave a harbour next morning. The time of getting under way and the speed required have been previously indicated; the number of boilers necessary to light up for this speed has to be decided upon. One condition the mercantile engineer finds himself called upon to determine which never troubled him in his liner, and this matter, rightly or wrongly determined, has considerable effect upon fuel economy, and every ship must be ready in all respects to take up her allotted place in the line at the moment the flagship is moving out of harbour. The liner crew would find this somewhat different to leaving Liverpool or Southampton in the quiet methodical manner they are accustomed to. Probably the squadron is not an hour outside the harbour when the Admiral signals to "exercise general quarters." This touches every one in the ship, and those who have been up all night getting up steam, &c., have to attend their station for an hour or two. It would be vain for the mercantile man to plead that he was tired or sleepy, and if he did not get his rest he could not do his work at the next watch on. To his station he must go, and perform such duty as is allotted to him; no comfortable bunk here for him to get the sleep he did not get last night. I think he already wishes himself back on board the Campania, and as twelve o'clock approaches he begins to think him of his dinner before he goes on for the afternoon watch; but every one in the ship has been employed at general quarters during the forenoon, and dinner is only half cooked or not cooked at all, and our mercantile friend finds himself in front of his boiler or on the engine-room platform feeling very empty in the lower regions, and if I know the man rightly, work under these conditions he will not do, so the steam pressure drops, the revolutions necessary for keeping station cannot be obtained. Meanwhile the flagship is furiously signalling to know why the ship is out of station; the captain sends for the chief engineer; he, as his practice has been, takes his time before appearing. All this time matters are getting worse, and eventually the ship has to fall out of line, and wait until the firemen of the Atlantic liner feel well enough to get up steam again. This, and very much more like this, is what would probably happen if the transposition of engine-room crews suggested by "Fidley House" took place. Much more could be written showing that although seemingly alike, the duties of and the manner of life peculiar to battleships and liners are very widely different, and the men accustomed for years to one kind of life do not readily settle down to the other.

With regard to the causes of the breakdowns of machinery in the Navy which "Fidley House" says he hears so much of, it would have seemed wiser in him to have suspended his awful judgment and comprehensive sentence of incompetency which he pronounces on the whole body of naval engineers, until the Committee now inquiring into this very matter have made their report. It is more than probable that their verdict will not agree with that of "Fidley House;" in fact, it is not unlikely they may suggest that there are not enough naval engineers, whereas "Fidley House" thinks there are already one thousand too many.

Your correspondent goes on to speak of "Rear-Admiral Melville's scheme." Really, for one who professes to have studied the subject of naval engineering so widely, there is a sad lack of knowledge displayed. He presumably refers to the report of a mixed committee of line and engineer officers presided over by Mr. Roosevelt, at that time Assistant Secretary to United States Navy Board, and which was presented to Congress in 1897; he thinks Admiral Melville rates the work of naval engineers too highly, and proceeds to the statement that the work of the engine-room is not intellectual. This may be true of the mercantile marine; but so far as the Navy is concerned, if there is no need for intellectual men to officer the steam department, then they are not required for any other department of that great service.

November 27th. A Naval Encumbrance.

Sir,—Having just read your able article on "Naval Engineers," I cannot refrain from expressing my opinion that there is a great deal of truth in what you say, more especially that part alluding to the pleasant nature of one's duties, and the social aspect generally. As to the working of the "department," and how it should be officered, I will not enter any further than to say I do not agree with you, for if you only require one superintendent—no understudy—for the steam department, the same thing would hold good for the executive branch, and no one else but a captain required except, say, the ship's company and warrant officers.

In a private firm no one would be required except the manager over the working men, thus giving our directors of big shipping firms very little credit for business capacity, seeing that they employ so many men of various grades between the workman and the manager. I certainly do not approve of the idea of making the naval engineer an executive officer in such as way that the duties could be interchangeable.

But I am strongly in favour of the chief engineer of a ship having more control over his men; in fact, being executive in his own department.

It is an undoubted fact that executive life is far more pleasant than engineering life, and should the two lines be joined, no doubt many engineers would work their interest to get on deck, whilst, on the other hand, others from deck would be sent below as an engineer.

Naval engineers have only what is termed relative rank, and I can assure you, Sir, that with many years' experience the term is a perfect farce. One has only to look at the cabin accommodation given to the head of the steam department in our battleships and cruisers when those ships are built to show what relative rank means. He generally has a stuffy little place down below, whilst others, perhaps of far less service, get a bright and airy room of almost palatial proportions. When a ship is in commission a better cabin sometimes falls vacant, and the captain kindly allows the engineer to use it. There are many instances of such, but that is quite a private arrangement. There are many little troubles in every walk of life, but I feel sure the Admiralty would have had, and would now have, far greater assistance from their senior engineer officers to smooth over many little difficulties that may take place if it were not for the fact of themselves being the recipient of so many little "pin pricks" from head-quarters. The late revision of pay is another glaring instance, officers being actually called upon to "refund considerable sums" to the Admiralty, as well as having their income reduced. This, Sir, is a reward for long and meritorious service, as it is called. I should call it a premium on "sloping." I am sure you will agree that there is no one on board a ship who requires a breath of fresh air so much as the engineer; yet when a ship is built, even to the very latest all over the country, you will find in the choice he has the smaller one; if there are any obstructions then he is given that one. If there is a stuffy one, he probably will get it on the excuse it is near the engine-room, as if the whole ship was not the engine-room, more or less.

Personally I have had very comfortable ships, but that has been due to the kind consideration of my captains, and the good fellowship of my messmates.

To sum up, I think most of these agitations which seem to periodically spring up are due to a want of consideration in comparatively small things. Let the engineer have executive control in his own department, and let the Government take the lead in showing that his services are as necessary as those of other officers. He at present has "relative rank;" let it be shown that he receives relative treatment in all things—he asks no more—and I think all the little points of friction, where any may exist, would soon cease. Dum Spiro Spero.

November 24th.

Sir,—One reason why engines in the Navy break down is the neglect with which they are treated when ships are sent out as reliefs. A crew is put on board abroad to come home after a three years' service. They take no interest in the ship, which only, so to speak, is hired to bring them home, as a man might take a cab from a railway station.

Everyone in the inside ring knows that general slackness all round is the plague of our engine-rooms. When discontent reigns rampant, good work will not be done, and a chief can be almost driven to suicide by a crew of slackers. R.N.

Portsmouth, November 26th.

WATER SUPPLY.

Sir,—It cannot be disputed that for many reasons prevention of waste is a matter of rapidly increasing importance in this country, but it must not be supposed that water engineers have the solution entirely in their own hands. In several cases in my own experience, where the waterworks have been in the hands of the public authorities, it has been thought better to increase the supply than to create friction with the consumers by appearing to curtail their use of water. Consulting engineers, however, for obvious reasons seldom go out of their way to make a strong recommendation for the reduction of waste; and resident engineers are apt to be more anxious to have their names identified with the creation of new works than with the more humble *rôle* of preventing or postponing the necessity for them. In my opinion their plain duty always is first to educate their authorities to the importance of the question, and then to endeavour to bring the consumers to a proper sense of their responsibilities. The latter, at least, is a most difficult and trying operation where people have been allowed to acquire the habit of wasting inordinately large quantities of water, and of allowing fittings to remain out of order in the belief that thereby the drains are kept sweet. They can seldom be convinced of the fallacy of this belief, and the only remedy is to carry out frequent and systematic inspections and to follow them up rigidly, so as to ensure as far as possible that no preventible waste be allowed to take place. All fittings should be of the best quality and of a suitable type, and there should be no hesitation in condemning those found to be unsatisfactory. The engineer should be supported by his authority in a whole-hearted manner, and should be empowered to take legal proceedings in all flagrant cases, at least against both careless and intentionally wrong-doing householders. All such water-wasting appliances as, *inter alia*, the so-called automatic "slop-water" closets, should be interdicted, as where these exist the householder has practically no choice but to run large quantities of water to waste if he would keep disease from his door. I have myself found in a working-class locality, where the houses were fitted with these closets, as much as 150 gallons per head consumed during the twenty-four hours of a hot summer day. In cases where sanitary authorities and water companies do not see eye-to-eye on this point, the latter might well follow the example of the Norwich Company, who, a few years ago, refused to supply water to houses fitted with these abominations, and who were practically supported by Parliament in their action.

The most effective method of detecting waste is a question admitting, I think, of little discussion. No doubt substantial results can be obtained by means of night tests with the stethoscope, and day tests with the ordinary hammer are by no means to be despised. Indeed, the latter is the only system used in a large manufacturing town in the Midlands, where a domestic supply of, I think, seventeen gallons per head per day is found to be most ample. Inspections cannot, however, be carried out in a thoroughly systematic manner, and perfectly satisfactory results obtained, without the aid of a waste meter—preferably, I think, of the Deacon type. This system is too well known to require description in a technical paper, but it has one important recommendation which is sometimes not made sufficiently prominent. That is, that by no other means can an engineer exercise a proper supervision over his waste-detecting department. The diagrams are indisputable records, and can readily be translated in the office to books showing where and to what extent wastes were actually taking place during the tests. The day inspectors are handed these lists, and their duty is to stop each one of them or give a satisfactory reason why they cannot do so, and the next test shows at once to what extent they have been successful. Under any other system the inspectors are turned loose on an unsympathetic world, with instructions to work certain districts and "stop all waste." Sometimes under the stethoscope system they have rather more definite instructions, but they know that there is practically no check on their work, and on this account, and from the aimless monotony of them, they lose interest in their duties, and the best of them are apt to deteriorate into little better than loafers. In a properly conducted meter system, on the other hand, the inspector feels that the engineer has him in hand, and that the shape of the next test diagram depends greatly on himself. He therefore takes an intelligent interest in his work, and is a better workman and a better man in consequence.

It is impossible to say definitely what is a sufficient quantity of water to provide for all legitimate domestic purposes, as so much depends on the class of property and the habits of the people. A better class residential town, fitted with baths and water-closets, might well require thirty or even more gallons per head per day, but an ordinary manufacturing town should not, I think, consume more than one-half of that quantity, the figures in both cases, of course, including an allowance for what might be called unavoidable waste.

Our present system of basing domestic water charges on the rateable values of the houses may seem a rather absurd one, but it is little more so than that of charging poor and district rates in precisely the same manner. A £200 house may not use twenty times more water than one rated at £10, but neither does it derive so much more direct benefit from the sewers, streets, and schools, which, like water, are considered among the public necessities of a town, the general principles underlying the whole system being that a man may reasonably be asked to pay according to his supposed means for the general health and well being of the community to which he belongs.

Universal metering of domestic supplies at a uniform rate per 1000 gallons would, I think, be found to relieve the rich at the expense of the poor, which would surely be a retrograde step, for which, if the distribution of the supply be properly managed, there is, at present at least, no justification.

Allow me to apply the principle to the district in which I live. The water company here supplies some 55,000 houses, with an average of 5½ persons per house; 70 per cent. of these houses are rated at £10 and under, and are charged for at rates ranging from 13s. 6d. to 6s. 6d. per year, which includes for one water-closet. The average price obtained for water pumped is at present 5½d. per 1000 gallons. Probably a saving of almost 25 per cent. of the water pumped would be effected by universal metering, and, as the company's dividends could not be allowed to suffer by the change, the price would have to be correspondingly increased. A similar allowance would also have to be made for unavoidable waste from mains and services outside of the meters, and for

defective registration of the meters themselves. These would increase the price to be charged from 5½d. to about 9½d., and deducting ½d. saved in fuel owing to the decreased quantity of water to be pumped, the ultimate price for water delivered into the houses would have to be at least 9d. per 1000 gallons. Taking eight gallons per head per day as a reasonable allowance for a cottage house with a water-closet, each of these houses would require 44 gallons per day, which, at 9d. per 1000 gallons, would amount to 12s. per year. To this, however, would have to be added a sum to cover the interest on the first cost of the meter, and for repairs and renewals. This could not be taken at less than 10s. per year, and the yearly water bill would therefore amount to 22s. per year for houses at present charged 13s. 6d. to 6s. 6d.—surely not a strong argument in favour of universal metering.

The meter rent itself seems to kill the proposal, but I do not see that any less expensive method of measuring the water could be found. Some such cistern as the "Simplex" might possibly be adopted for use as a measuring apparatus, but the annual cost could not be appreciably less than for an ordinary meter. Moreover, in the district I take as an example there is not now a single house cistern, except for bath and w.c. supplies, and I feel sure that the sanitary authorities would strenuously object to their adoption, and rightly so, as the supply has been for many years maintained in the fullest manner, and is generally admitted to be perfectly satisfactory.

Another insuperable difficulty would be in obtaining payment of the water bills. At present the owner of houses rated under £10 is responsible for water rates, and he, of course, recoups himself by an addition to the rent. He could not, however, be expected to make himself responsible for a tenant's carelessness, which might easily run up a water bill to an amount greater than the rent of the house. To obtain payment directly from the tenant would be quite impracticable, as people of that class seldom stay long in one house, and leave at a week's notice. In any case they cannot be made now to pay a greater sum at one time than a week's rent, and the receipt of a quarterly water bill, perhaps larger than usual, would simply mean that the tenant would escape the collector by removing to another house. Those of them having the intention to pay would be apt to stint their supply to a dangerous extent, and those having no such intention would probably, by their wastefulness, run up bills to such an extent that they could not pay them even if they would.

November 22nd. R. C. FRAIN.

SIR,—Many readers of THE ENGINEER will thank Mr. Ingham for the information freely given in his letter of November 9th, and be pleased to know that he has become a Progressive and abandoned the dear old Conservatism. The four towns mentioned as supplying water by meter are far too small for comparison with other well-ordered towns having a population of, say, 50,000. These are the only instances, I believe, in the United Kingdom, and it is not stated whether they pay expenses, or are similar to many corporation works, who borrow from other rates to cover the loss sustained through supplying water by meter. Abingdon has a population of 7000, and uses 700 meters, the consumption being 5½ gallons per head per day. Malvern has a population of 9000, and uses 880 meters, the consumption being 20 gallons per head per day. Matlock Bath supplies 28 gallons per head per day, and charges 2s. per 1000. I shall watch with great interest for the publication of the experience of the engineers of the towns here enumerated. My experience goes to prove that if they charged 3s. per 1000 gallons, and paid the engineer and employé fairly, there would not be an enormous profit gained as claimed by the meter advocates. The Odessa Water Company is an instructive example of vending water by meter, there was no dividend paid for twenty years, and in the end the whole concern went over to the Odessa Corporation. Water by measure in American cities is a good remedy for the enormous waste allowed to go unchecked by any properly organised method of inspection. If any town in England used 250 gallons per head per day, as at Pittsburgh, U.S.A., and it could not be prevented, of course it would be correct to adopt a meter supply, with a minimum charge sufficient to cover the cost of the installation, and a percentage to provide for the rent of the meter, if "the meter forms a part of the works of supply, just as much as an engine or a pipe line!" But who shall own the meter is a question that cannot be settled so easily or satisfactorily off-hand. Of course, the consumer cannot be allowed to own the meter, for the reason that he could not be compelled to keep it in repair, and it would be to his interest to let it go out of repair, especially where inferential meters are used, as suggested by Mr. Ingham. Under registration is the rule with old meters, and if the consumer sent the meter for repairs he must have another to replace it whilst the old one is away, and he would receive most of his supply gratis. Such a system could not possibly work. On the other hand, the company owns all meters and keeps them in proper repair, to the mutual advantage of both parties, selecting the proper instrument most suitable to the various requirements. The inspection, reading, and repairs become a large item in the maintenance of the distribution department, and the rate per 1000 gallons must be raised to meet the cost of alterations and the new installation. No matter whether water is supplied by a corporation or a company, it cannot be measured without expense, and should be vended at a profit the same as any other commodity; therefore the price fixed per 1000 gallons should cover the expense of the meter precisely the same as the selling price at present covers the expense of the "engines and pipe liners," &c. In a town like Torquay, with a population of 50,000 and only 180 meters, it is evident that the trades are not metered. Surely list A should be metered, viz., dairies, mews, slaughter-houses, dye-works, inns with urinals, hotels, colleges, fishmongers, photographers, urinals, gardens, farms, and—most important of all—that modern sanitary fraud, the automatic flusher. Will any engineer believe that there are towns in England, including London, where this sanitary (?) fitting is fixed direct on the main and allowed to run day and night without being measured, and often without any payment? The figures quoted by Mr. Ingham do not allow for a profit on the undertaking, although 1s. 4d. per 1000 gallons is charged, and, as stated before, much should be done in metering all trade supplies for which the Acts of Parliament already provide. Twenty-one million gallons per annum does not nearly represent the trade supply of Torquay. Considering the small number of meters in use, there must be numerous other trade purposes arranged for by the "antiquated system of charging on rateable value." This is a relic of the obsolete practice of charging for watering roads by the mileage system, and flushing sewers without the use of a meter. No one can judge even approximately of the quantity of water that may be used for trade purposes, or through a hose for garden purposes. I am of opinion that most companies charge by meter for trade and mixed supplies. Although there are numerous methods adopted for gauging the supply, such as filling the flush tank of known capacity by a pipe laid into the flushing tank, and taken direct from the main, the tally of the number of times this hole is filled is kept by the sewer man. Many of these tanks are fitted up with ¼in. cocks for controlling the water supply, and set to fill the tank in twelve hours; but when the inspector goes to try the arrangement, he finds the sewer man has set them to fill every hour. Again, there is the pea ferrule and discs, with different sized apertures used instead of meters as provided for by Act of Parliament for trade purposes.

The question first raised in THE ENGINEER of July 27th was, "The comparison between the cost of water wasted and the cost of detection or prevention of waste." Some figures are given which have not been disputed. Mr. Ingham has not given the cost of detection of waste for the whole of Torquay, which is most essential to thoroughly understand the figures quoted, viz., £270 cost of detection of waste on a further supply of 300,000 gallons per day.

Your readers will be glad to know that this and kindred subjects are to be discussed by the British Association of Waterworks Engineers at their winter meeting in London. This will be a large assembly of experts, and all water engineers will find it to their advantage to assist in the discussion of a particularly valuable and interesting programme.

November 20th. DISTRIBUTION.

VENTILATION AND HEATING.

SIR,—Your correspondent, Mr. R. Gordon Mackay, is not very consistent. He is pleased to be facetious about the date of my previous letter, and after his attempt at facetiousness, and his remarks anent another correspondent's abuse of the architect "for paying less attention to ventilation than ornament," it is somewhat amusing to find him expressing precisely the same opinion as your correspondent respecting the architect's incompetence to deal with the question of "warming and ventilation." This, he remarks, is a branch of engineering quite outside the architect's province, and then he goes on seriously to advise that much-abused personage to take the advice of an expert on this subject before getting out his plans.

The importance of fresh air in the prevention of disease and in reducing the death-rate, not only among human beings but amongst the lower animals in this and other countries, has been so abundantly demonstrated during recent years, that it seems to me no apology on my part was needed for referring to an article which appeared some time back in your columns. This article made most valuable practical suggestions, which could not be too widely read, and my object was to point out that such a simple system as you suggested in your article had been successfully adopted in my own dwelling-house, and that it enabled humble individuals like myself to obtain an abundant supply of warm, pleasant, fresh air without having to incur the expense—which in most cases would be quite prohibitive—of adopting fans or other mechanical appliances.

As a matter of fact, however, the letter which you did me the honour to print in your issue of November 3rd, and which has so perturbed Mr. Mackay, was written in February last directly after your article appeared, but, owing to an inadvertency on the part of a clerk, it was not posted until a few weeks ago.

As showing the results practically obtainable by this simple and inexpensive system of heating and ventilating without mechanical appliances, I append copy of an analysis of air taken by a leading firm of analysts in Manchester—Messrs. Crace, Calvert, and Thompson, Royal Institution Laboratory—from a doctor's house in the neighbourhood of Manchester:—

Carbon dioxide (carbonic acid gas)	0·08
Oxygen	20·80
Carbonic oxide	Absent
Nitrogen	79·12
	100·00

The analysts remark that "the above analysis shows the air to be pure and free from any contamination with carbonic oxide or other products of combustion," and it will be observed that the amount of carbon dioxide does not exceed 8 parts per 10,000, which we have the authority of your correspondent, Mr. Mackay, himself for stating that "experts consider excellent ventilation." The analysts, however, further remark that the air entering the apparatus "was drawn from the cellar itself, and it is probable that the amount of carbon dioxide might be reduced to about 0·05 per cent., *i.e.*, 5 parts per 10,000, by drawing it from the outside."

Now, notwithstanding Mr. Mackay's remarks on the strangeness of my advocating such a system of supplying air for dwelling places and public buildings "in these days of so-called enlightenment," I submit that the results obtained, as shown by the above analysis, are such as to justify its adoption by any householder or even corporate bodies who desire to have efficient and healthy heating and ventilation at a moderate cost. When the analysts further add that this system would be well adapted for operating-rooms in hospitals, because "any pathogenic organisms contained in the air would be destroyed by passing through the hot tubes, and we expect to find that the air in an operating-room so heated would be free from germs or pathogenic organisms of any kind, and would thus materially reduce the risk of septic poisoning during operations," it will be seen that we have here a simple and inexpensive means of obtaining pure air in our dwelling-houses and other buildings, with which, at any rate, so far as first cost is concerned, mechanical ventilation cannot be compared.

It may be, as your correspondent states, a matter of "common knowledge" that an air propeller or fan is the most efficient means of supplying air to public buildings, &c., but it is also common knowledge that it is by far the most efficient means of creating intolerable draughts, and it is far and away the most expensive. Ventilation by mechanically-propelled air may possibly be the best system to adopt for wealthy Corporations who have an unlimited supply of public money to spend, but Mr. Mackay can, perhaps, tell us in how many instances thousands of pounds have been spent in adopting a system of mechanical ventilation which has been an utter failure. This does not, of course, by any means imply that the system is wrong. It may be the best, and merely require perfecting or carefully carrying out; but air propellers and fans require power to drive them, and either a steam engine, a gas engine, or an electric motor must be provided. Hence there is not only the enormous first cost to be considered, but the continuous cost of the motive power afterwards, and the skilled attendance; and I would ask how many dwelling-houses, churches, chapels, &c., are there where not only the first cost would be absolutely prohibitive, but where no facilities exist for the provision of power. I submit, therefore, that if simple arrangements, somewhat as suggested in your article, of supplying warm air to the upper part of a room and withdrawing the vitiated air at the floor level either at the skirting or through the floor, and carrying it away up above the ridge of the building, can be successfully adopted—and I trust I have shown that it has been done—this would provide a sufficiently healthy means of heating and ventilating our dwellings and places of resort which would be well within the means of any small congregation or any householder to adopt.

Moston, Newton Heath, Manchester, November 26th. WILLIAM INGHAM.

SIR,—With reference to the letters on this subject that have lately appeared in your journal, your readers may have concluded, and correctly, that successful ventilation may be had by more than one kind of appliance, and that the best appliance is that which is best suited to the building and the skill and resources of the user. The word ventilation is derived from two Latin words which mean wind or air and motion; and all men in the business find out sooner or later that it is the movement of the air in the room or building that is the chief thing to study, whilst the means to produce and sustain the movement have to be chosen and arranged to suit the user.

Speaking broadly, all ventilation divides itself into two classes—warming combined with ventilation in winter, and ventilation for cooling in summer. The first class must have an apparatus for warming the fresh air supplied for ventilating the place, but the second does not so positively require a plant for cooling the fresh air, as sufficient cooling effect can usually be had by quickening the speed of the air currents, which can only be done by mechanical or artificial ventilation, of course. In both classes the position of the air outlet affects the result far away more than that of the inlet. For warming in an ordinary room the outlet must be near the floor, whilst for cooling, in all buildings, it must be above the people's heads, but by no means therefore in the ceiling. It should not be more than 5ft. above them, for it is the air among the people that must be renewed and removed, and the air out of reach does not matter. The reason for this altered position for summer or winter work is the temperature of the outside walls of the building. In summer these are warm, in fact, often hot, and they warm, by contact, the already warm air in the room, causing it to ascend; if it cannot escape by some outlet aloft it will travel along the ceiling until it finds some wall not as hot as the others, by which it is cooled enough to descend, and a continuous circulation of all the air in the room is thus set up and kept going. In winter exactly opposite conditions are found; the cold outer walls now chill the air warmed by the heating apparatus and the people, and there is a down-current at the walls and windows, and in consequence the outlet must be at the skirting so that it draws off the chilled air. If Mr. Stephens tests a room in winter with the upper and lower outlets he will find that the upper outlet requires from 30 per cent. upwards more fuel to keep the place warm, and that the distribution of the fresh air is not equal to that by the low outlet. In crowded buildings, such as theatres and public halls, floor outlets are seldom advisable, as the air cannot easily get to them, and a horizontal current over the people's heads from inlet to outlet will be found to give the best results.

In conclusion, may I say a word in defence of the architects? Though there is a great deal of difference between the materials used and the purpose and duty of the finished work, yet architects and engineers are equally constructors, and anyone who has had the good fortune to meet both will readily grant that the best architects are equal to the best engineers in talent, skill, character, and attainments. OS. WHEELER, A.M.I. Mech. E.

November 29th.

THE EFFICIENCY OF FANS.

SIR,—A very few words will, I think, serve to answer Mr. Granger's letter of November 5th.

I have not written a word or advanced an argument to prove that the *évasée* chimney was not efficient. Far from it. I know that it is of great utility, and I have known it for many years, whereas Mr. Granger seems to think he has made a new discovery. I did, and do, insist that his theory of the action of the chimney is wrong, and he no longer asserts that there is a vacuum due to reduction of pressure at the throat of the chimney. That, as I have said, is the place where the density of the air and its elastic pressure is greatest, not least.

The diverging jet of water is more efficient than the parallel jet, for reasons which Mr. Granger will find fully set forth in treatises on hydraulics, and need not be discussed here.

The apparent loss of pressure at the throat of a fan discharge pipe is due to an inductive action which has been explained a thousand times, and has nothing whatever to do with the density or elastic pressure of the moving column of fluid.

I have not put forward the explanation of the action of the *évasée* chimney as my own. It is the usual normal explanation, and Mr. Granger has, so far, advanced nothing whatever to prove that it is erroneous, or to substitute a better explanation for it.

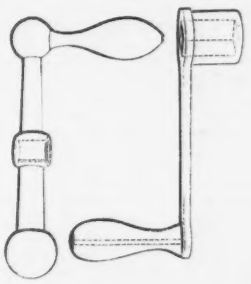
Westminster, November 26th. P. W.

ENGLISH *v.* AMERICAN TOOLS.

SIR,—In reference to the respective merits of English *versus* American tools, may I draw your attention to a matter, small in detail, but yet, in my opinion, showing the difficulty of procuring what one requires from English manufacturers.

In our works we have working side by side English and American tools. Not always is the advantage in favour of the Americans; but in one little point, viz., the handles, we find that the American pattern is far preferable to the English. They wear longer, are far more easy to manipulate, and cannot get lost, and our men far prefer them to use.

Some short time ago we were having a machine specially built by a well-known English maker, and we requested him to fit the



American pattern handles to the machine. This he point blank refused to do, as he informed us that he considered his own were far preferable.

This may or may not be the case, but surely in a little matter of this kind it would be policy for him to have considered the requirements of his customer, and he might have done this certainly without loss to himself, as from the accompanying sketches you will, I think, see that the English handle is certainly as costly, if not more so, than the American.

This is no doubt a small matter, but it illustrates the difficulties which we have on more than one occasion had to contend with with English makers of machine tools.

FRANCIS H. CRITTALL,
Manor Works, Braintree, Managing Director, Crittall
November 22nd. Manufacturing Company.

GAS AND OIL ENGINES AT THE PARIS EXHIBITION.

SIR,—The author of the article No. III. in your issue of November 16th complains that the English exhibitors gave no details of the latest tests to people desirous of inspecting the engine.

Permit us to say that we gave away many thousands of the enclosed eight-page reprints of the official report of the latest important public trials of oil engines, also a similar number of twenty-four-page catalogues in English, French, and Spanish, fully explaining our engine. Only a glutton for detail would expect more. We were, of course, particularly anxious to circulate this report, because our engine holds the first place in the trials, and to the best of our knowledge establishes a record for general efficiency in this and all other countries. In justice to English manufacturers we hope you will make this public.

(FOR BLACKSTONE AND CO., LIMITED),
EDW. C. BLACKSTONE,
Managing Director.

Rutland Works, Stamford, November 27th.

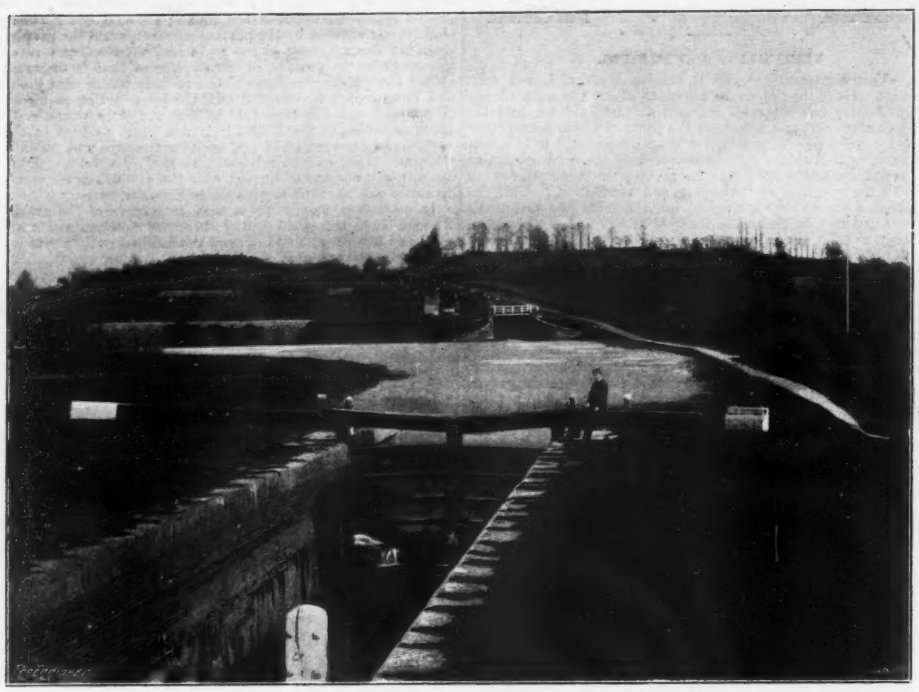
THE NOVIK.

SIR,—We notice that in the article on the new Russian cruiser in your issue of November 16th you express uncertainty as to the type of boiler with which the Novik is fitted, and surmise that they are probably Bellevilles. This is not so; the boilers are of our Daring type, and are similar to the boilers fitted in our most modern destroyers. JOHN I. THORNYCROFT AND CO.

Church Wharf, Chiswick, London, W.,
November 23rd.

THE Smithfield Club Show will be held at the Agricultural Hall, Islington, from December 10th to 14th inclusive.

DEVIZES LOCK, KENNET AND AVON CANAL.



A REMARKABLE OLD WATERWAY.

Certainly one of the most remarkable of our great artificial waterways was the once famous Kennet and Avon Canal, and upon this the flight of fifteen locks near Devizes was, in its day, considered a masterpiece of skilful engineering. We lately had an opportunity of inspecting this work, which is still in use and maintained in excellent order by the Great Western Railway Company, the present owners of the canal. Starting from Northgate-street Bridge, at the upper end of Devizes, there first begins a series of six reaches or lengths of canal, of from 150 to 200 yards long by about 60ft. wide, evidently intended to serve as reservoirs for the flight of locks below. A portion of one of these upper pounds is set apart as a public bathing-place, but the clearness of the water, owing to the small traffic, perfectly justifies the rather unusual choice. Close to Devizes Gaol the road from Trowbridge crosses the canal on the skew. The western face of the arch bears a tablet to the memory of John Blackwell, 1840, who during thirty-four years superintended the works of the canal as engineer with fidelity, vigilance, and ability. Both this bridge and Northgate-street are fine works executed in Bath stone, and of a type considerably superior to the ordinary canal bridge of brick. The tow-path has a separate arch, or tunnel, rather low and narrow. At the seventh lock from Devizes, beginning with one at Northgate-street, the brow of the hill is reached. The view here over the beautiful woodland country towards Bath is alone worth a visit; below stretches, in orderly procession, the long flight of locks, the wooden gate-levers standing out on each side like the oars of an immensely long boat. A notice on the left recalls one of the weak points of the canal system, namely, that the navigation had to be stopped for about a week early in June for cleaning out. That period of the year always used to be chosen for this purpose, notice being given in the papers.

At this seventh lock a foot-bridge leads across to some small workshops, one or two boats lying in the pound awaiting repairs. The pound is the first of fifteen, all alike in size, projecting on the north side from the line of locks. Each lock, in fact, has one. The pounds, which, of course, are intended to provide an ampie supply of lockage water and at the same time economise it, the first lockful going down the hill, accompanying a boat all the way; are about 60 yards wide and 75 or 80 in length, transversely to the canal route. Going up the hill one lockful is wanted out of each pound; but they are large enough to supply this many times over. Practically the traffic must be equal in each direction, as whichever way the bulk of the cargoes travel the boats must come back, full or empty. Such pounds are generally used on the half-lock system, and effect a considerable economy.

The bottom pond of the flight, making sixteen, is triangular. In it are the remains of a curious old disused dredger. The lock gate leading out of this pond westwards has been renewed in boiler plate, but all the other gates are of wood, as usual. A great deal of work has been done at these locks of late years, replacing defective bricks with hard blue ones, repairing woodwork, &c., and the Great Western Company certainly cannot be accused of having let the navigation go to decay. Below the "boiler plate" lock Marsh-lane Bridge crosses the canal against Foxhanger's House, after which are six more widenings, similar to those at the top of the flight. At the bottom lock the tow-path crosses over to the north side by a bridge near Lower Foxhanger's Farm, but a disused passage for it shows that it originally continued on the south side. The railway bridge a little further on seems to have necessitated the alteration. Beyond here, to the end of the line, there are only three detached locks and two flights, one of five at Seend, and another of seven where the canal locks down into the Avon at Bath, at the back of the Great Western station.

There are thus no fewer than twenty-nine locks within about 2¼ miles of Devizes, fifteen of these following each other as closely as they can be got in, the total fall being 235ft. 5in. All are of the same size, viz., 74ft. 6in. long, 14ft. 3in. wide, with 6ft. 3in. of water on the sills. Though the two first dimensions are common enough, the depth on sill is greater than usual, although often exceeded. These locks took some years to make, the rest of the canal having been in use a considerable time before they were finished. Meanwhile there was a railway up the hill, doubtless a single line of cast iron tramroad, occupying the site of the present towing path. Possibly it was a self-acting incline, but we have not been able to obtain any particulars of it. Anyhow, it was done away with when, on December 28th, 1810, the line of navigation was opened throughout and it became possible to send barges through from London to Bristol.

Except a tunnel 500 yards long, on the summit level, over which the shunting yard at Savernake Junction has been formed, there are no other works of particular importance. The tunnel is about 470ft. above the sea, 17ft. 4in. wide at the usual water level, and 13ft. 2in. high in the centre. Chains are fastened to the walls for the boatmen to pull on—not a pleasant business, but much better than "legging" through. Between Bradford-on-Avon and Bath are two very beautiful aqueducts, Dundas and Avoncliff, carrying the canal across the Avon. Probably the elder Rennie, the engineer who made the canal, designed these works also, but it is certain they are a great credit to their architect. The small bridges near the Sydney Gardens, at Bath, are also handsome structures; in fact, the whole navigation has been designed on a scale and in a style much superior to the ordinary narrow boat canals of the Midland Counties. At the surface the width is stated to be 44ft., at the bottom 24ft., with 6ft. of water over the greater part. At Devizes the water is full of fish, and seems always to have been remarkably clear there, for in 1828 it was proposed to supply the town with water from the canal. Not far from the Dundas aqueduct a long level is partly supplied by pumps worked in the river Avon by the stream itself. These pumps are mentioned, as about to be put up, in a description of the canal published in 1811. It seems to be an official publication.

Nothing is said, amongst a great deal about the expected traffic, of running passenger boats, but on May 27th, 1833, experiments were made with a light iron vessel on the reach running from Devizes eastwards towards Wooton Rivers. Apparently they were successful, for a year later Messrs. C. and R. Parker's "elegant and fast-sailing Scotch boat" went twice a day from Bath to Bradford and back with passengers and luggage. Horse-power, however, not sailing, was employed. In 1835 Lansdown and Co.'s boat, Royal William, ran every afternoon from Bath to the Avoncliff aqueduct, except on Mondays, when it went to Bradford. Both these vessels started from near the Sydney Gardens, above the locks, and the service was kept up, at any rate in summer, for many years.

The length of the middle, or purely artificial portion of the Kennet and Avon Canal, extending from Newbury to Bath, is 57 miles. This is now called Section 2. The eastern portion, Newbury to the Thames at County Lock, Reading, 18½ miles, is the river Kennet, originally canalised under an Act of 1715. Such work was not then well understood, the lock sides being left unwalled, and the whole was reconstructed and opened, with part of Section 2 to Hungerford, in October, 1798. This Kennet portion contains twenty-one locks, some of them 130ft. long, and averaging 16½ft. in width; but it was not finally acquired by the Canal Company till 1807. At the other end, Section 3 is the river Avon from Bath to Hanham Mills, a few miles above Bristol. This bit, of eleven miles, was made navigable by an Act passed in 1712, and acquired and improved by the canal nearly a century later. It has six locks, but after a long drought is of very little use for navigation. From this portion, in Bitton parish, a railway was made about 1830, running northwards to the coalfields about Westerleigh and Coalpit Heath, some six or eight miles. It joined another line, called the Bristol and Gloucestershire Railway, where Mangotsfield North Junction now is. A good deal of the line remains, although disused all but a short bit from Oldland Colliery to the river below Keynsham. It was called the Avon and Gloucestershire Railway, but its proprietors were really the Kennet and Avon Canal Company. Both lines used horse power, and were of 4ft. 9½in. gauge, laid with wrought iron fish-bellied rails in very small chairs affixed to stone blocks. The line had been projected so early as 1803, but was not authorised till 1828, and opened about three years later.

By means of this line the canal company got a large coal trade into its own hands. It supplied Bath, and the whole extent of country up to Reading, Gloucestershire coal even being sent, to a limited extent, through to London by the Thames. For some thirty years an excellent business was done and good dividends paid by the Kennet and Avon Canal, till the opening of the Great Western Railway in 1841 dealt its through traffic a heavy blow. As worse would clearly follow from the extensions of the Great Western south of the main line, the canal, as a last despairing effort, promoted the London, Newbury, and Bath Direct Railway Company in 1846. The intention was to convert the navigation into a railway, but sanction could not be had, and nothing remained but to make the best terms possible with the victors. By a deed of transfer, dated July 29th, 1852, the canals, railways, and entire property passed into the hands of the Great Western for the sum of £210,415, about one-fifth of what they had cost. As the payment was in Rent-charge Stock and 4½ per cent. debentures, and the canal is worked at a loss, the former proprietors have had the best of the bargain in the long run, after all.

LABOUR TROUBLES.

On Sunday last two mass meetings of railway men were held in Birmingham. The first was of Great Western men of all grades, Mr. Beck presiding. At this a resolution was adopted requesting the Executive Committee of the Amalgamated Society of Railway Servants to inform the Great Western Railway Board of Directors that unless they met the delegates of the grades now petitioning by the end of December a new movement of all grades would be started. In the evening a second meeting was held of those men employed on all the railways in Birmingham, when a resolution was passed to the effect that the time was ripe for an advance of wages for all grades of employés, and agreeing with the resolution of the annual general meeting asking for 10 per cent. advance on present wages, with time and a-quarter for overtime, and time and a-half for Sunday work.

Mr. James Holmes, of Cardiff, in addressing this meeting, said that during the last month fifty-three men had been killed on railways. Many of these would not have been killed had railway companies been as interested in life and limb as in dividends. During the last four years 2000 men had been killed and 20,000 injured. In trying to get legislation from a Government actuated largely by railway directors, they were awkwardly placed. Many deaths on railways would not be permitted in any other business concern. Mr. Holmes concluded by warmly advocating legislation to prevent losing life and limb, not compensation after the accident. He condemned the apathy of railway men—a quarter of a million were eligible and not half were enrolled. These non-unionists were the men upon whom directors relied to frustrate all attempts at improvement.

A large meeting of seamen and firemen at Barry was addressed last week by Mr. J. H. Wilson, president of the National Sailors' Union. He spoke at length of the adverse condition under which the seafaring population of Wales existed, and said that, whereas at Southampton, where most of the seamen were unionists, wages were £4 10s. and £5 per month, at Cardiff, where the men were not so united, the current rate of wages was 20s. less. Deputations under the auspices of the Union were to wait shortly upon the President of the Board of Trade and the Home Secretary; in the former case to secure a recognition of the universal scale of provisions on board ship, the sailor being at present fed for about 6d. per day; and in the latter case, to urge the inclusion of sailors and firemen in the Workmen's Compensation Act.

On Thursday Mr. Wilson spoke to a large meeting of sailors in Cardiff, when he stated that the present scale of provision on board ship was largely responsible for the 14,000 deserters of seamen from British ships at the present time. He referred also to the accommodation on board ship, which he regarded as totally insufficient. The Royal Commission on Labour had recommended 120 cubic feet, instead of 72, which the Act provides at present, but nothing had been done to give effect to the recommendation. In conclusion, he commented upon the necessity for the inclusion of seamen and firemen in the scope of the Workmen's Compensation Act. Every week, he averred, scores of seamen were permanently injured, and yet not a penny compensation was awarded. The workhouses were the asylum for these. The ships on board which these men were injured did not contribute to the poor-rate, but every small shopkeeper had to pay his rate to keep the workhouse where the seamen have to pass their days.

The Penrhyn Quarry rupture has had, after all, a disastrous ending. After settling on Wednesday to resume work, a further mass meeting was held on Thursday evening, when the following notice from Mr. Young was read:—"Notwithstanding my notices of November 3rd and 19th, there has been further disturbance and intimidation this day at the Penrhyn Quarry, and the employés have again ceased to work without permission. I therefore give notice, in accordance with the reservation named in my notice of November 19th, that the quarries are now closed. The tools, &c., to be removed before 12 p.m. on Saturday, 24th. Signed, E. A. Young." The quarries have been duly closed, and the latest report is to the effect that several hundreds of the quarrymen have left to seek employment at the colleries in South Wales.

The latest phase of the quarrymen's strike is the positive refusal of the management to accept the mediation of the Quarrymen's Union, as between master and man; nor will a third party be seen in the matter. A deputation of the men will be seen at any time. Upon the men agreeing to work peaceably, the quarry will be at once re-opened to them. The men are taking up quite as resolute an attitude, and the exodus from the mines to other industrial centres is incessant. Large numbers have left for Holyhead, where the London and North-Western Railway are carrying out extensive changes.

The lightermen's dispute now promises to be the subject of legislation. A Bill is to be deposited in the House of Commons by Dyson and Co., which aims at doing away with the rights of the Thames lightermen. It has been framed to legalise the working of barges, lighters, and other like craft, in the tidal portion of the river Thames and the docks by competent persons other than licensed watermen or apprentices.

The Institution of Mechanical Engineers.—During the discussion on Mr. Twinberrow's paper it was stated in our report that Mr. Wainwright, locomotive superintendent of the S. E. and L. C. and D. Railway, spoke. This is an error. The speaker was Mr. John W. Wainwright, of the British Thomson-Houston Company.

The Institution of Electrical Engineers.—The Council of the Institution of Electrical Engineers has arranged, with the kind permission of the Institution of Mechanical Engineers that, if the discussion on Mr. Langdon's paper on the 29th should be adjourned, a second extra meeting should be held, also at the Institution of Mechanical Engineers, on Thursday, December 6th.

INSTITUTION OF ELECTRICAL ENGINEERS.

INAUGURAL ADDRESS,

By Professor JOHN PERRY, M.E., D.Sc., F.R.S., President.

(*Concluded from page 527*)

OUR knowledge of electrical phenomena must be quantitative to be of practical use; we must be able to calculate. Mathematics is the science of calculation, and we must therefore be able to employ, and we all do necessarily employ, less or more mathematics every hour of our professional lives.

I know of long misleading accounts of the results of good experimental observations which might have been described in a few clear words by the aid of elementary mathematics. I know men who spend on a particular problem ten times the amount of worrying thought that would enable them to master the easy mathematics that includes all such problems. Quite recently one of our most eminent members declared to me that he had not really grasped the reason for small economy at a power station when there is a small load factor until he studied the commonsense mathematical form which has been given in a recent publication. And yet he is a man who has heard much, and read much, and talked much on this subject.

Every electrical engineer has a correct idea of how a transformer acts, or how the E.M.F. in one of the coils of an armature of a direct-current or other generator, or, let us say, a rotary transformer, changes during a revolution, and how the E.M.F.s of all the coils are combined to produce currents in the external circuits. But through how much mathematical tribulation must most of us have passed from our state of ignorance to our present state of knowledge! It is no wonder that we are disinclined to the study of a new phenomenon which seems as if it might lead us through the like tribulation. The tribulation is least because it is suffered only once if we first learn the Calculus method which underlies all our work; it is greatest if we get it up in a completely new-looking form in every new problem. I speak now of what is most difficult in our study, for there is thought required in applying the Calculus method. Thus, for example, in multiphase work at the present time the best mathematicians wonder how it is possible for easy calculation to be made in such a subject. What we want just now is that an electrical engineer acquainted with three-phase current phenomena should be so much a master of ordinary easy mathematics that he has a chance of discovering a very simple way of putting the matter before us. At present calculation is easy but tedious, and, indeed, repellent; but I am perfectly certain that a competent man might quickly invent methods of calculation which are not only easy, but short and thinkable. Mathematicians with the requisite electrical knowledge, again, may be lacking in sympathy and humour. I know a book of more than 300 large pages on ordinary alternating currents, and all the information in it is given far more simple in two pages of another book with which some of you are acquainted. Possibly, just now, mathematicians who are electrical and who have common sense have too much other work to do, and we must wait their leisure.

The fact is, mathematics ought to be the natural language of the electrical engineer, and at present it is a foreign language; we cannot read or write or think in it. We are at the beginning of our development, like monkeys whose necessities have increased faster than their powers of speech.

Some of you are aware that a new method of teaching mathematics has recently been introduced in nearly all evening classes in science schools throughout the country.* I wish I could say that there was a prospect of its being introduced in all schools, for it seems to me that this would lead to the result that all young men entering works would be masters of that kind of calculation which is most important in electrical engineering; not merely a few men having this power, but the average men, just as average men can read and write.

I am addressing engineers, men who utilise the results arrived at by scientific workers, men whose profession is applied science. But surely if we are to apply the results arrived at by scientific men, if the laboratory experiment of to-day is the engineering achievement of to-morrow, we ought to be very much alive to all that is going on in the scientific world.

All men ought to be far more alive to the importance of scientific work. On the psychological side, it is perfectly exasperating to me to see how few are the men who know that Darwin has given a key to almost all the great philosophical problems of antiquity, and that there is a great mental development accompanying the more evident engineering development now going on in the world. Again, it is the fault of our methods of education that all our great men, our most important, most brilliant, best educated men, our poets and novelists, our legislators and lawyers, our soldiers and sailors, our great manufacturers and merchants, our clergymen and schoolmasters, should remain so ignorant of physical science, the application of which by a few men not ignorant is transforming all the conditions of civilisation.† But of all men just think what it means for engineers to be ignorant of science, or neglectful of its new developments, and of all engineers think what it would mean if electrical engineers sinned in this way.

Except ours, all other branches of industry have taken thousands of years to grow. There were bridge and hydraulic and sanitary and harbour and river engineers in ancient Rome, and such engineers existed thousands of years before the first papyrus was written in Egypt. But no Assyrian tile or Egyptian hieroglyphic or relic from a tomb indicates that telephones or electric motors or electric lights existed before our time. No gradual improvement in our methods of conquering Nature led up from small beginnings in our electrical engineering. Our profession has not grown during thousands of years of time like other professions. It has sprung suddenly, full grown, from the new spirit which is going to rule the souls and bodies of men, the spirit of research in pure science. The new spirit puts knowledge, mere knowledge of Nature, as its highest aim. The scientific student knows that all sorts of good must come to mankind from his studies; all sorts of scientific knowledge are sure to be utilised by engineers, but in the pursuit of science the usefulness and utility of the result are of no importance. And are we—we who have received the first-fruits of the labours of scientific men, we the first-born spoilt children of the great parent of all that is to come, we who form the foremost files of the present time—are we going to turn upon our beautiful young mother and say she is useless and ugly, and she hinders our money-making, and that we are willing to kill her for the sake of the burial fee? Thank God that is the spirit of only a few of us. Have we not as an Institution gone to great expense in the publication of *Science Abstracts* in partnership with the Physical Society? That publication has been and continues to be of the very greatest value to all students of pure and applied science who read our language, for it tells them the results of all the scientific work now being done in all parts of the world. And even if some of us do not read that useful publication, do we not know that it is there to read if we like? Do we not know that it is a symbol of our redemption from the yoke of the Philistine? It is one of many signs that in answer to the question which I have asked in this address, we can truthfully say that we are professional men, that our profession has promise of enormous expansion and improvement, and that we are not mere tradesmen.

I am afraid that you will think that I have a personal interest in putting before you the claims for consideration of the pursuit of pure science, because you know that I am trying to defend Kew Observatory from imminent danger. In truth I have no interest in this matter unbecoming a president of this Institution. For two years I have been trying to reason with traction engineers. Like many other electrical engineers, these gentlemen desire to use uninsulated return conductors. If they do so near a magnetic observatory certain records of terrestrial magnetic disturbances are quite spoilt. At Potsdam this sacrilege has been forbidden. At Washington, Toronto, Capetown, and most other important places, the magnetic records have already been rendered useless. Professor Rücker and I were asked by the other members of the Committee of the Royal Society which was in charge of the Kew Observatory to defend Kew, and with the help of her Majesty's Treasury we thought we were able to insist upon the use of insulated returns in all undertakings authorised by Parliament where harm was likely to be inflicted on Government observatories. I may say that the scheme designed by Mr. Clifton Robinson for using an insulated return conductor in the working of the tramways of the London United Tramways Company, in consequence of our action, was a thoroughly good scheme which it gave one satisfaction to look at, not ugly and not expensive. It seemed to me a fit scheme for any tramway system, however complex, in which overhead conductors are used. You are aware that for an electric railway, or for a tramway where a conduit is employed, it is in every way better, and is in a large scheme actually cheaper to use an insulated return. We felt, therefore, very happy, for magnetic observatories seemed quite safe from interference. We were, however, mistaken, for the only clause which we have been able to get inserted in all parliamentary authorisations of undertakings leaves it to the Board of Trade to substitute other methods of protection than the insulation of the return conductors in cases where these other methods seem to be sufficiently good for the protection of laboratories and observatories, and this is why the Board of Trade appointed the Committee which met on October 31st probably for the last time.

Professor Rücker, Professor Ayrton, and I have made many tests on the magnetic disturbances produced by tramways and railways, particularly by the Stockton tramways and by the Waterloo and City Railway, and we have had many meetings with the traction engineers, but nothing has yet been decided.

I mention this matter, which has given great anxiety to scientific men, because I am afraid that some of you may think when you hear of it that I have been acting against the interests of the electrical industry. I beg to assure you that I have been acting in your best interests. As an electrical engineer, I ought surely to regret the use of uninsulated returns, even if we leave Kew Observatory out of account. Suppose we do not now insulate our returns. Electricity will certainly return by gas and water pipes, and the amount of harm done to those pipes is merely a question of time. Because of the ignorance of legislators and gas and water companies, nothing is said just now, but will nothing be said at the end of ten or twenty years, when pipes are found to be eaten away everywhere? And if by a slight increase of expense, or rather, as I think, actually no increase of expense, but merely a little increase in inventiveness and common sense on the part of electrical engineers, this evil may be entirely prevented, surely it is in the interests of all of us that insulated returns should be insisted upon. But even if we do not insist on insulating the returns in all systems, surely something may be said for the giving of this protection on lines near such a magnetic observatory as Kew. Even the magnetograph records now being made have been continuous for forty-five years, and if Kew is interfered with no sum of money can compensate for the interference; for if the Observatory were removed the future observations would have no link with the past.

An engineer in this room declared that it seemed to him an injustice to hamper the progress of electric tramways "for the sake of making observations that never have given and never may give to the world any important results." Now, it is not so much on account of Kew that I object to this sort of observation, as to its general spirit of antagonism to scientific research.

There is no doubt that the answer to the old question which Gilbert might have asked three hundred years ago, "What is the cause of terrestrial magnetism?" is very jealously hidden from us by Nature. The earth probably contains much iron, but its great internal heat seems to forbid our imagining the iron to be magnetic. The assumption that a negative electric charge on the rotating earth will explain things, requires such an enormous charge that this assumption has been discarded. There are annual and diurnal variations of a fairly regular kind; there are storms which have some relation to the Aurora Borealis, to sun-spots, and to earth currents. There are small sudden changes which seem to occur almost instantaneously all over the earth. Observations of these things may be useless from some points of view, but scientific men have been and continue to be willing to give up time and much money for this object. Utilitarians had to be cajoled through superstition to allow observations of the stars to be carried on in ancient times, and we have no such cajolery to offer. We simply say that it has been through this sort of useless-looking method of working that all our progress in science has come.

Engineers descended from men who sneered at Cavendish and Franklin, and Volta, and Oersted and Ohm and Faraday, are you who utilise the results of the work so sneered at and pile up fortunes in consequence of it—are you the men to sneer at and ridicule the scientific work of the present day because it seems to you useless?

Tell us a better method of observation; give us better suggestions as to what these magnetic phenomena may mean; but the past record of scientific observation enables us to laugh at you when you say that magnetic observations may never give the world any important results. Was Nature ever so open and yet so closed about a secret as she is about this one of terrestial magnetism? Was there ever one whose revelation promised so much? How very little we know of electricity and magnetism! Does the mere motion of the earth, taking no account of electric changes at all, cause it to be magnetic? Almost everything is on the cards. Surely I need not appeal to your cupidity, but it is quite possible that our knowledge of this secret may enable us to trap a tremendous store of Nature's energy.

Gentlemen, this is not a trades union, and it is not a society for the furtherance of pure scientific research, but it is a society of professional men who recognise the past services of scientific observers with gratitude and respect, and hope for greater ones in the future. And shall it be said of us that our gratitude is not greater than that of Judas, to whom, indeed, thirty pieces of silver was doubtless a large sum; that "we have given our hearts away a sordid boon;" and that as to our future hopes we are willing to sell our birthright for a mess of pottage?

* See summary of lectures on Practical Mathematics; also the Science and Art Directory, and the Reports of Examiners on the Science Examinations of 1899 and 1900, all published by the Education Department, South Kensington, S.W. The reforms now advocated in mathematical and science teaching are all clearly described in a paper read before the Society of Arts in January, 1880.

† See articles in *Nature* of July 15th and August 2nd.

THE COMPARATIVE EFFICIENCY OF TRIPLE AND QUADRUPLE-EXPANSION ENGINES.

AT a meeting of the Manchester Association of Engineers held on Saturday last, Mr. A. L. Mellanby, M.Sc., read an interesting paper on "The Relative Efficiencies of Triple and Quadruple-expansion Engines," in the course of which he gave the results of tests that had been carried out upon triple and quadruple expansion engines working under similar conditions. These experiments, he remarked, were made upon the engines at the Durham College of Science, Newcastle-on-Tyne, which were at present the finest experimental engines in the country. They were made at pressures varying from 90 lb. to 210 lb., and they showed that for the whole range the greatest power was given by the quadruple set, but that the difference between the brake horse-power in the two cases was less than the difference between the indicated horse-power. This was also borne out by the fact that the mechanical efficiency of the triples was higher than that of the quadruples. In all the trials the quadruples used less water per indicated horse-power than the triples. Other tests he had made seemed to indicate that the water consumption of an engine would be increased if they lowered the exhaust pressure of the high-pressure cylinder, even when the point of cut-off in the high-pressure cylinder was kept constant. Part of this increase could be accounted for by reason of the smaller amount of cushion steam in the cylinder when the back pressure was lower. The clearance spaces were therefore not quite so full when admission took place, and consequently an extra amount was let in per stroke. The explanation generally given for the other increase in what might be termed the missing quantity was that there was an increased amount of condensation due to the greater range of temperature with the lower back pressures. This statement had, however, never been proved by direct experiment. Messrs. Callendar and Nicholson had brought forth evidence to show that initial condensation did not play so great a part in the steam consumption of an engine as was generally supposed, and that the greater part of the "missing quantity" was due to direct valve leak. The writer had shown by experiment that this leak was directly proportional to the difference between the steam and exhaust pressures. It was therefore of the greatest importance to keep the back pressure of the high-pressure cylinder fairly high, and this indicated the necessity for great attention to be paid to the size and point of cut-off in the second cylinder of multiple-expansion engines. In conclusion, Mr. Mellanby remarked that up to the limiting pressures of the experiments—90 lb. to 210 lb.—there seemed to be little advantage in having quadruple-expansion engines, rather than triple, particularly when it was remembered that the cylinder ratios for the triples experimented with were not at all good. In his opinion, with our present lack of knowledge, the adoption of triple and quadruple-expansion for increased economy was most unscientific. The correct thing to do would be to find out exactly the cause for increased consumption with decreased back pressure in the high-pressure cylinder. If this, as Dr. Nicholson stated, was chiefly due to valve leak, and initial condensation had only a secondary effect, attention should be especially directed to methods of preventing this valve leakage by the design of suitable valves. This would then enable them to use compound engines for higher pressures with a greater number of expansions than was at present feasible. Further research upon the reasons for the "missing quantity" was therefore absolutely necessary, and he would respectfully direct the attention of engine builders towards it, as the chief difficulty to be solved before the consumption of steam engines could be reduced by any substantial amount.

In the course of discussion on the paper, Dr. Nicholson observed that the question of leak was more fundamental to a knowledge of the working of an engine than that of cylinder condensation. At the new Manchester Technical School means were to be provided in connection with the experimental engine for carrying out further tests on this question of valve leakage. Mr. Gregory remarked that in trials made by the firm he was connected with, the results would seem to indicate that the triple was more economical than the quadruple engine. Mr. Robson said the draining of the receivers between the cylinders would appear to be of some importance in connection with Dr. Nicholson's theory of valve leak. Mr. Alfred Saxon related an experience of his own which, he observed, seemed to go directly against the author's idea as to back pressure. He also suggested that it would not be a bad plan if a research committee were formed to carry out experiments on large engines with a view of testing such points as had been brought forward by the author. Mr. Mellanby, in his reply, stated that the results of his experiments showed a much smaller advantage in point of efficiency in favour of the quadruple than one was led to expect. The draining of the receivers had a considerable effect on the economy of the engine. Mr. Saxon's suggestion as to forming a committee was an admirable one.

INSTITUTION OF ELECTRICAL ENGINEERS: GLASGOW SECTION.—At the first meeting of this local section of the above Institution, which was held in the rooms of the Institution of Engineers and Shipbuilders, Bath-street, on the evening of the 14th inst., Lord Kelvin presided, and before calling upon Mr. W. A. Chamen, city electrical engineer, to read a paper on "Electricity Supply," gave a short address describing the object of the local section which had been formed, and expressed satisfaction at seeing an attendance of over 100 at their first meeting. Mr. Chamen then read his paper, which was divided into two general sections—first, the system; and secondly, the pressure of supply. The conclusions arrived at in the paper were:—(1) That there was no more economical or satisfactory method of supply than low-tension continuous-current generated upon a site or sites within the area of supply if possible, and supplemented by a small amount of high-tension plant if necessary, in order to supply remote corners of the area which might be beyond the reach of low-tension supply. (2) That if it were impossible to find sites within the area at any reasonable price, and with railway accommodation and freedom from onerous restrictions due to surrounding proprietors, then a high-tension generating station or stations without the area would be the next best arrangement, though the cost of supply would be increased to some extent. A continuous current, however, should be supplied to customers. With reference to the pressure of supply, the author brought forward strong arguments in favour of a 250-volt declared pressure supply. In the discussion which followed the reading of Mr. Chamen's paper the following, amongst others, took part:—Lord Kelvin, Professor Magnus Maclean, Messrs. W. B. Sayers, J. M. M. Munro, Sam Mavor, Bailie McLay, &c. A vote of thanks, on the motion of Lord Kelvin, was awarded the author.

THE INDIAN TROOPSHIP HARDINGE.—The Indian troopship Hardinge, launched from the Fairfield Shipyard last August for the transport service of the Indian Government, was tried on the Firth of Clyde on the 15th inst., with highly satisfactory results. The trial, which was most exhaustive, included six runs over the measured mile off Skelmorlie, and six hours' steaming at full power. The result was a mean speed of 19 knots, this being considerably in excess of the contract requirement. A good deal of interest—locally at least—has centred in the building and trials of this vessel, as it is over thirty years since a troopship was built on the Clyde, and the Hardinge is only the second vessel of this class built in the district. We gave a detailed account of this vessel at the time of her launch—see ENGINEER, August 17th, page 169—and only the leading particulars need here be recapitulated. The gross tonnage of the vessel is 5600 tons, her dimensions being 423ft. 6in. length overall, 407ft. between perpendiculars, 51ft. breadth extreme, and 31ft. depth to main deck. There is accommodation for about 1600 persons, of which number over 1400 will be military officers, troops, &c. Having regard to the climate in which the vessel will be employed, the ventilation has been arranged on the most complete system possible, and electric light is fitted throughout. There is large refrigerating plant by J. and E. Hall, of Dartford, on their patent dry-air carbonic system, with cold storage for meat, vegetables, and other provisions, also for making ice, cooling drinking water, &c. The propelling machinery consists of two sets of triple-expansion surface-condensing engines, having three cranks, and three cylinders, 29in., 46in., and 72in., by 4ft. stroke. The boilers are five in number, of the ordinary cylindrical multitubular marine type, four of them double-ended, and one single-ended, the former having six furnaces each, and the latter three furnaces, all arranged to work with Howden's forced draught. The Hardinge has been built under the superintendence of Sir E. J. Reed, K.C.B., who was on board at the trial as naval architect and engineer, representing the India-office. Dr. Francis Elgar, Admiral Morant, and Mr. Gracie, of the engineering department, represented the Fairfield Company, and after the trial the vessel returned to the Fairfield dock to fit out for the voyage to Bombay.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

Ice handling machinery.—There is probably no country in the world where ice is so generally used for domestic and other purposes as the United States, and this has led to the development of special machinery and appliances for cutting, storing, and handling natural ice, as well as for manufacturing ice. American machinery for natural ice has been installed in Norway. In harvesting ice, the rectangular blocks are floated to an inclined elevator or conveyor, consisting of two endless chains driven by sprocket wheels by means of a steam engine or electric motor, the chains being connected at intervals by oak boards which carry the blocks up the incline to the gallery along the side of the storage house. In the undershot elevator, the return side of the chain is carried on rails above the incline, while in the overshot elevator the return side descends vertically to the ground and back along the ground to the sprocket wheel idler in the water. The blocks are floated to the elevator and caught by the boards as the chain rises from the water, and are discharged at any desired height by means of traps which drop them into inclined runways. The gallery along the side of the building, from which the blocks are sent into the house, is on an incline, so that the blocks slide along until caught by the door men. The speed of the blocks depends largely upon the state of the atmosphere, the noon sun making the surface soft, so that the blocks will not slide as fast as on a cold frosty morning. Adjustable galleries are therefore used, suspended by wire cables from the eaves, and are made in 30ft. lengths. Thus the door men can vary the height and slope of the gallery as required, and no extra men are required to push the blocks along the gallery. Vertical elevators are used in some cases, especially where the blocks have to be carted from the water to a distant ice house. Similar devices are also employed for lowering the blocks on to wagons for the market or for distribution.

Coal staiths.—The Norfolk and Western Railway is building at its Atlantic terminus a new coal dock 860ft. long, for coaling large ocean steamers, there being a depth of 30ft. of water on each side of the pier at low tide. From the storage yards the cars—with 30 to 50 tons of coal per car—drop down a gradient of 1 in 133, and 1 in 75 to the foot of an incline of 1 in 4, up which they are hauled by a winding engine to the top of the pier. Down this they run on a gradient of 1 in 150, being stopped at any desired point, and dumped into one of the coal pockets at the side. The empty car then goes on to the end of the pier, and is shunted on to a return track having a continuous gradient of 1 in 35, back to the storage yards. There are three tracks on the pier, the two outer ones for loaded cars and the middle one for the empty cars. On each side of the pier are 27 pockets or loppers fitted with discharge shoots or spurts, which can swing 12½ft. on either side of the normal central position. There are two sets of these spurts, 31ft. and 47ft. above high water when in position for discharging. The pier is of steel, having four rows of latticed columns, carrying two decks side by side, while between these decks runs the deck for the return cars. The deck or floor is 70ft. above high water, and the two loaded tracks are 36ft. apart between centres. The three decks are carried by plate girder longitudinals, and there are longitudinal stiffening trusses. The columns are alternately 25ft. and 50ft. apart, the 25ft. spacing being filled in with diagonal bracing. The two middle columns are inclined so as to rest on the same foundation, the pier having three cylinder foundations to each set of columns. The cylinders are of ⅝in. cast iron; the middle one is 10ft. diameter, enclosing 20 timber piles with concrete filling. The outer ones are 6ft. diameter, with seven piles in each. The tops of the piers are at high-water line, and the width of the pier over the wooden flooring 6ft. above this level is 56ft.

Chimneys for power stations.—The new chimney at the 96th-street power station of the Metropolitan Street Railway—or Tramway—Company at New York is the largest in the United States. Its total height above the foundation is 353ft. At the base it is 55ft. diameter, reduced in 20ft. to a diameter of 39ft., which is retained for 60ft. It then tapers to 27ft. in 233ft., and widens out in a moulding to a diameter of 35ft., while the diameter at the top is 25ft. The double shell begins at 100ft. above the base. The outer shell is from 24in. to 16in. thick, and the inner shell from 20in. to 8in. thick, the lower part of the latter having a 4in. firebrick lining. The inner flue is 22ft. diameter. The maximum unit loads are 157 lb. per square inch for the outer and 161 lb. for the inner shell. The boiler horse-power is 21,750 horse-power, and the capacity of the chimney is ample for this at 3lb. to 4 lb. of coal per horse-power per hour. The draught will be about 1⅝in. of water. Mr. Christie, the author of "Chimney Design and Theory," thinks the use of a single chimney was a mistake. In case of an accident to the chimney, or to the large flues where they enter it, the entire plant must be shut down. It is also improbable that the entire boiler plant will be in operation at any one time, as the power required for an electric tramway system is continually changing, and the maximum is required only for about three or four hours per day. This will result in an uneven draught. Under these conditions, he considers a single chimney designed for the maximum duty is an uneconomical investment. As the boilers are arranged in three tiers, with two batteries to each tier, he suggests that six or twelve chimneys would have been better. For twelve chimneys of about 2000 horse-power each, they would have been 7½ft. diameter and 225ft. high. Built of steel, brick, or radial brick, they would have been cheaper than the one large chimney, and would have provided a uniform draught for whatever number of boilers might be in operation. Still greater economy and efficiency might have been attained by much smaller chimneys in connection with mechanical draught appliances, for induced or forced draught.

Another complete combustion furnace.—In view of the cheapness of soft or bituminous coal, and the increasing restrictions of municipal authorities in regard to the smoke nuisance, a number of furnaces have been devised—with more or less success—to burn soft coal without smoke. One of the most important points to be observed in this respect is the thorough mixing of the air and gases at a high temperature, a condition for which the ordinary boiler furnace is ill adapted. In the new furnace above referred to, the furnace proper is placed in front of the boiler instead of directly beneath it, thus giving room for means to cause cross currents which will ensure the desired mixing of the gases. At the same time it is so arranged that the gases from the fresh coal must pass through a bed of incandescent coal, or rather coke, thus ensuring still more perfect combustion. The grate has an inclined surface for fresh coal, and at the bottom there is a horizontal surface for incandescent coal, this latter having a brick arch just under the end of the boiler. Air enters from the ashpit under the fresh coal and through openings above this coal. In working, the space between the flat grate and the brick arch is full of incandescent coal, while the top of the fuel bed from the inclined grate to the face of the arch is formed of fresh coal. The cross currents of air effect a good mixture of the air and gases, and all the air and gases must pass through the mass of incandescent coke to the flue under the boiler. A bridge wall reduces the height of this flue to 12in. at the middle of the boiler. In one case with a boiler of 1800 square feet heating surface, the grate area is 19½ft. for the inclined grate, and 8¾ft. under the arch. With a steam pressure of 87 lb., 38,664 lb. of water were evaporated into dry steam by 4200 lb. of coal, developing 204 horse-power. The actual evaporation was 9·206 lb. per pound of fuel, or 10·896 lb. from and at 212 deg. The efficiency on a basis of 13,250 B.T.U. per pound of coal was 79·42 per cent., and the coal consumed per horse-power per square foot of grate area under the arch was 70·95 lb. The boiler had a manufacturer's rating of 150 horse-power. The chimney was practically smokeless.

THE Newcastle Corporation have received eight tenders for the widening of Byker Bridge.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

IT is satisfactory to know that a good deal of the outside competition in steel boiler plates and some other descriptions of steel required for engineering purposes has become much less severe than lately, and the consequence is that local makers are able to fill requirements which previously were satisfied from outside sources. There was therefore a more cheerful tone in steel on 'Change this—Thursday—afternoon in Birmingham. £8 to £8 10s. was understood to be the usual quotation for mild steel plates made under the basic system, whilst £8 to £8 5s. was asked for girders and angles, £8 5s. to £8 15s. for steel bars, £6 5s. to £6 10s. for Siemens billets, and £6 to £6 5s. for Bessemer.

The sheet iron trade is causing some anxiety again just now. It was thought recently that one or two more of the mills would have to be closed owing to low prices and want of profits, but it appears now that operations will be continued, at any rate until the end of the year. Singles are quoted £8 15s. to £8 17s. 6d.; doubles, £8 17s. 6d. to £9; and trebles, £9 10s. to £9 12s. 6d. Stocks of sheet iron are accumulating again, and are now heavier than for a long time past, so that unless things improve a curtailment in production will have to be resorted to. Galvanised sheets are somewhat weaker, doubles being obtainable at £12 10s. or less. The export demand, however, keeps satisfactory. Hoop iron remains £9 to £9 10s.; nail-rod and rivet iron, £9 5s. to £9 15s.

In crude iron a moderate amount of business is offering, but consumers are again adopting bear tactics. The quotation for Northampton forge qualities is generally 57s. 6d. to 60s., but like most other pig iron quotations just now, these figures are to a great extent only nominal. Derbyshires may be put at 58s. 6d. to 61s. In Staffordshire pig iron also, hand-to-mouth buying seems to be the order of the day, and prices are weaker than of late in actual business. Staffordshire cinder forge is quoted 60s. to 62s. 6d.; part-mine, 62s. 6d. to 65s.; all-mine, 65s. to 77s. 6d.; best, 90s. to 95s.; foundry, 100s.; and cold-blast, 120s.

The engineers and manufacturers of Birmingham were very pleased to learn on Wednesday that the Cardiff County Council have had the matter of the improvement of the waterway from Bristol Channel ports to Birmingham again under consideration. The last-named body have appointed delegates to accompany a joint deputation representing South Wales trading interests, which has been formed to meet the Birmingham City Council to discuss the promotion of a Bill in Parliament for improving the navigation from Gloucester to Birmingham. The Cardiff Chamber of Commerce is one of the Welsh trading bodies which will also be represented.

In the South Staffordshire district, where a good deal of puddled iron is still made, though not to the extent which obtained in former years, a paper of special interest was that which the Staffordsnire Iron and Steel Institute had before them on Wednesday last, the author being Lieut.-Col. L. Cubillo, Assoc. Inst. C.E., from the Royal Arsenal, Trubio, Spain. The title of the paper was "The Chemical Phenomena of Puddling." After describing the chemical history of the charge, the author endeavoured to explain in what manner the oxidation of the impurities eliminated, and the iron oxidised during various experiments, was effected. His experiments were undertaken to elucidate one of the most important points offered by the study of the operation of puddling, namely, the oxidation of the metalloids and metals which occur in the cast iron, in order to ascertain whether this oxidation is caused by the oxygen of the oxidising coating of the furnace, or by the oxygen of the gases which come from the hearth, the slag serving merely as a vehicle for the oxygen, as Grüner believed. The furnace employed is one of the simple or ordinary type with the addition of a Boetius hearth and a small chamber or furnace to heat the pig iron before introducing it into the laboratory part of the furnace. In the judgment of the author, if it is demonstrated that the quantity of the oxygen in the slag is the same as that contained in the ore used, no doubt can remain that it may be affirmed with complete exactness that the coating of the furnace exclusively supplies the mineral necessary, and that the gases of the furnaces play no other part than that of supplying the necessary heat for the operation. This, of course, takes into account the fundamental principle in chemistry, of the indestructibility of matter.

The heavy as well as the light and medium trades of Dudley should benefit if success attends the efforts which are being made by the Chamber of Commerce of that town, and also by the Town Council, to improve the existing facilities for technical and commercial education. Negotiations are in progress between those two bodies with reference to the establishment of a central educational authority for the borough in the same way as Blackburn and some other towns have done. The Dudley Chamber of Commerce have this week decided to suggest to the Town Council the amalgamation of the School of Art Committee and the Technical Instruction Committee to form the proposed new authority.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The extremely unsatisfactory situation throughout the iron and steel trades of this district shows no signs of improvement, the continued downward course of prices tending only to still further weaken confidence, with the consequent restriction of buying to the narrowest possible necessities. In face of this persistent fall in material, there is no corresponding reduction in the cost of production, and the position of makers and manufacturers becomes more and more serious. The price of fuel is one of the main difficulties, and there is talk of blowing out furnaces unless expiring contracts for coke can be renewed at substantially under current rates, whilst forge proprietors are insisting that unless they can purchase both pig iron and coal at much lower rates, the stoppage of works will be the only alternative to carrying on operations at a considerable loss.

The position of the engineering industries, in contrast with the depression of the steel and iron trades, remains generally one which does not give rise to any really serious complaints. Hydraulic engineers report a fairly satisfactory weight of new work coming forward. Wagon builders are similarly well off, and the position with respect to locomotive building and electrical engineering remains much as I have recently indicated. A fair amount of activity is still maintained in structural engineering work, and the leading machine-tool makers are kept fully going; but taking the position generally, the new work in prospect is not at all of a pressing character.

Only the most limited inquiry continues to be reported on the market here for either raw or finished iron or steel, and, where business of any moment is in question, quotations are very irregular, but practically there is nothing of sufficient magnitude being put through to test what prices might really be taken. In pig iron there is still simply a hand-to-mouth business doing at excessively low-cut prices, and the general tendency continues in a downward direction. During the week there has been a further easing down in makers' quotations, without, however, placing them in any better position for meeting competition in the open market, as merchants still quote below makers where there are orders to be got. Lancashire makers quote nominally about 75s., less 2½, for No. 3 foundry, delivered Manchester, but there is little doubt that 2s. 6d. under this figure would be taken if actual business were offered. Lincolnshire makers have reduced the list basis 1s. per ton on all descriptions of iron. No. 3 foundry, delivered by rail Manchester, is now quoted 64s. 6d. net, but merchants' sellers at 63s. 6d., and No. 4 foundry quoted 63s., with this also to be bought through merchants at about 1s. less. Derbyshire foundry averages about 68s. to 69s. net, delivered Manchester. In forge qualities there is practically nothing doing to really test prices. Nominally, Lancashire makers are asking about 63s., less 2½; Lincolnshire are now quoting 61s. 8d. net, with offers from merchants reported as low as 60s. 2d., and Derbyshire brands obtainable from about 60s. 6d. to 61s. 6d. net delivered Warrington. Middlesbrough iron for prompt delivery remains at about the minimum quotations given last week, merchants being sellers at from 72s. 4d. to 72s. 10d., with makers asking about 1s. above these figures, by rail Manchester. Eglinton and Glengarnock, delivered Manchester docks, average about 74s. to 74s. 6d., with ordinary foundry brands of American iron quoted about 63s. to 63s. 6d. net cash. For forward delivery, however, all sorts of prices are quoted, and these are simply governed by the quantity and the extended delivery buyers would be prepared to take.

The position as regards finished iron shows no improvement. There is so complete a dearth of new orders coming forward that it is exceptional where forges have been kept going anything near half-time, and the question of some further reduction in prices was under consideration at a meeting held in Manchester on Tuesday. The extremely low rates at which Staffordshire iron is offering here—substantially under £8 being reported—and the extremely low figures merchants would be prepared to take, special lots of Belgian bars being obtainable at £7 10s., were brought before the meeting, and a further reduction of 10s. was strongly urged in some quarters as advisable under the circumstances. With, however, the present cost of production, any further lowering of prices would have to be a matter of the most extreme necessity, and it was decided that before any definite steps were taken further inquiries should be made. In the meantime list prices were to remain at £8 10s. for Lancashire, and £8 10s. to £8 15s. for North Staffordshire bars; £9 2s. 6d. for random, to £9 7s. 6d. for special cut lengths, delivered here, and 2s. 6d. less for shipment, with sheets about £9 10s., delivered Manchester district. Later on in the week it was decided as the result of inquiries to reduce the list price of Lancashire bars to £8 per ton.

A very depressed tone characterises business in the steel trade, and prices are extremely irregular. Ordinary foundry hematites are quoted about 87s. to 88s., less 2½; local made steel billets about £5 15s. net, with foreign billets much less; common steel plates and angle irons about £7 10s. to £7 12s. 6d., with the association rates for boiler plates still nominally £9, less 2½; but judging from some extremely low quotations by merchants for specified association plates, there would seem to be anticipations for a further very considerable reduction in the association basis before very long.

The metal market continues quiet, with manufacturers, as a rule, anything but pressed with work. List rates for seamless brass tubes have been reduced ¼d. per pound, bringing locomotive tubes to 8¼d., and condenser tubes to 9¾d. per pound.

By the death of Mr. Robt. C. Raby, of Raby, Fell, and Co., at the comparatively early age of fifty-one, the iron trade of this district has lost a well-known and highly-respected representative, and the announcement has been received with the deepest regret on the Manchester Royal Exchange. For some months past Mr. Raby had been in serious ill-health, and from the first his recovery had been looked upon as almost hopeless.

In the coal trade business generally continues to move on steadily, and if there is any change to report it is in the direction of some improvement. Meetings of Lancashire coalowners were held in Manchester on Tuesday to consider prices both for house-fire qualities and steam fuel, and it was decided to make no change for the present. Colliery representatives reported the position generally to be satisfactory, and so far as slack was concerned, the tone, taking it all through, was unquestionably stronger. In house-fire coals, although the demand is still not more than moderate for the time of the year, and stocks go on increasing to a small extent, requirements are perceptibly on the increase, and prices are very firm at the full list rates, best Wigan Arley being quoted about 16s. 6d. to 17s. 6d.; Pemberton four-feet and seconds Arley 15s. to 15s. 6d.; common house coal, 14s. to 14s. 6d. at the pit.

In the lower qualities of round coal collieries are still moving away their output without difficulty, the inland demand for steam and forge purposes continuing fairly good, and prices are well maintained at about 12s. 6d. to 13s. at the pit. For engine fuel an increased inquiry is the general report, with less plentiful supplies in the market, and this will no doubt be the position until after the Christmas holidays. The best qualities of Lancashire slack are strong at the full list basis of about 10s. to 10s. 6d. at the pit, and although the market is still unsettled by cheap surplus lots of the lower descriptions of slack offering from outside districts, this is not being felt to the extent experienced a few weeks back. Representatives of the leading Lancashire collieries report that they find a decidedly better market for slack, and where recently they might have been prepared to make some substantial concession to secure forward contracts, they are now not disposed to give way to any appreciable extent on current rates. There is, however, still very little actual business being settled in the way of contracts for next year, some of the largest consumers persisting in their policy of simply covering their requirements from month to month rather than enter into twelve months' contracts at the prices that the Lancashire coalowners are holding out for. The position just now with respect to forward contracts is that it is exceptional where under about 9s. 6d. would be quoted for the best Lancashire slack, though no doubt some of the largest and most important contracts would be dealt with at under this figure.

Shipping inquiry is slow, with prices weak, ordinary steam coals, delivered Mersey ports, not generally fetching above 15s. 3d. to 15s. 6d. per ton.

Quoted prices for foundry cokes remain at about 28s. to 30s. at the ovens, but there is undoubtedly an easier tendency in the market. Orders are not coming forward so freely, and the desirability of some reduction on present prices may have to be considered before long. For ordinary furnace cokes 15s. remains the minimum at the ovens, but consumers are holding back from contracting on this basis.

Barrow.—The hematite pig iron trade is somewhat weaker this week, and makers have at length been compelled to pull down their prices, mixed Bessemer numbers being quoted at 76s. 6d. to 78s. nominal, net f.o.b., while warrant iron is down at 76s. 2d., net cash sellers, buyers 2d. less. The demand for warrant iron is unabated, and during the week there has been a further clearance of stocks to the tune of 1580 tons, leaving stocks still in hand at 26,190 tons, and making the reduction since the beginning of the year 171,657 tons. If the make of iron could be increased at present there would be plenty of buyers ready to run up warrant stocks, which in the beginning of next year will be very valuable. Stocks are at a lower point to-day than they have touched for a considerable time past, and makers hold very few stocks themselves. They have still only 37 furnaces in blast, and two of these are employed on spiegeleisen. In the corresponding week of last year 47 furnaces were in blast.

Iron ore is in very full and very brisk request, and orders are exceptionally pressing for best sorts. Good average qualities are quoted at 17s. 6d., net at mines, with best sorts at 22s. and 23s. Good Spanish ores are firm at 19s. delivered at West Coast ports.

Steel makers are busily employed at the moment, but they do not hold very many orders, and winter prospects generally are unsatisfactory. There is not as full an inquiry for heavy rails as of late, but there are prospects of a brisker business next year. Prices are down at £6 10s. per ton for heavy rail sections, but business is reported as low as £6. There is a quieter tone in ship plates and in shipbuilding qualities of steel generally, and it is not probable much business will be done in this direction until a cheapened supply of coal has exerted its influence on trades generally as well as on the shipbuilding trade individually. A good business is reported in hoops and in merchant steel generally.

The shipbuilding trade is active so far as the orders in hand are concerned, but there is not any new business to note, although builders are now ready to take on new work, and are, in fact,

preparing to deal with a much fuller programme of operations in the early future.

There is still a very great demand for house accommodation in Barrow, and special efforts are being made to add an additional 500 houses to the scheme of Vickers, Sons, and Maxim, in the creation of Vickerstown on Walney Island.

Coal and coke are rather easier, and the supply is fuller.

The exports of iron last week stand at 7684 tons of iron and 10,527 tons of steel, as compared with 15,785 tons of iron and 9404 tons of steel in the corresponding period of last year—a decrease in iron of 8101 tons, and in steel an increase of 1123 tons. The shipments this year represent 582,944 tons of iron and 366,398 tons of steel, as compared with 478,050 tons of iron and 411,052 tons of steel in the corresponding period of last year—an increase in iron of 104,894 tons, and in steel a decline of 4,654 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE continued mild weather keeps household coal in the South Yorkshire district stationary, although values would certainly rise were frost and snow to give place to the present abnormal climatic conditions. Stocks are low, and as merchants buy very sparingly, it would not be hard, were severe weather to come, at least to maintain present high quotations. Consumers are still unable to obtain supplies at any reduction on the higher rates which have been ruling throughout the autumn. It is noticeable that stocks are beginning to accumulate at several collieries, and unless we get winter in earnest these piles will get bigger. Quotations are still maintained at 15s. to 16s. per ton for best Silkstones, and 14s. to 15s. per ton for Barnsley house. Here and there, however, less money has been accepted. In the steam coal trade no increase in the volume of business has to be reported. This class of coal is rather firmer than it was ten days ago, a steady demand for inland requirements fully compensating for the lesser weight ordered on export account. Inquiries for forward contracts are being freely made. Lower prices are anticipated, but owners are not disposed to conclude business on that basis. Barnsley hards are quoted 14s. to 16s. per ton. Already there is a good deal of talk as to the terms in which tenders are to be made to the railway companies for their supplies of locomotive fuel commencing on January 1st next. A meeting on the subject was held in Sheffield on the 22nd inst., when there was inquiry from one large railway company. It was agreed to reduce the quotations from 16s. to 15s. per ton for next season's contracts. The feeling is that this reduction of 1s. is reasonable; but the railway companies will certainly try to get still more relief. Several coalowners are disposed to stand by former quotations; these owners adducing the experience of the Midland Railway Company, which, refusing to fall in with the coalowners' quotation of 16s. per ton for Barnsley hards in June, found that they were not able to do any better—in fact, did worse for themselves—by buying in the open market intermittently during the half-year. In engine fuel there is rather more animation shown, nuts being 9s. 6d. to 10s. 6s. per ton, screened slack from 7s. 6d. per ton, pit slack from 6s. 6d. per ton. The production of coke has been materially diminished, and values are weak. Ordinary coke is now 14s. to 16s. per ton, washed coke from 16s. per ton, the latter quotation exhibiting a decline of 8s. 6d. per ton from the top prices.

The iron trade continues to get weaker. Consumers, anticipating further falls in quotations, restrict their buying to what they require for the moment. Although the recent reductions in quotations for finished irons have been exceptional, they have not yet brought about any improvement in the condition of business. Frodingham irons have dropped another 1s. this week. In iron circles no change is looked for in that direction until the coalowners give generous concessions. If it were known what reductions could be looked for in the price of fuel, ironmasters state that business would at once steady itself, as they would be able to make their arrangements for the future with something like certainty, which is entirely impossible at present. In pig iron there is a very quiet demand at home, which synchronises with the significant decline of exports to the Continent. West Coast hematites are now selling at 87s. to 88s. per ton; East Coast ditto, 86s. to 86s. 6d. per ton; Lincolnshire, No. 3 foundry, 65s. to 65s. 6d.; forge, 60s. to 60s. 6d.; Derbyshire No. 3 foundry, 65s. 6d. to 66s. 6d.; forge, 59s. to 59s. 6d. per ton; bars, £8 15s. to £9; and sheets, £10 to £10 10s. In the railway material trade, business is well maintained. In one department, that of accessories for locomotive building, there is abundance of work, and engine builders have more orders offered to them than they are able to take. Approached the other day with work for a leading railway company, one very large firm informed the management they could not accept any orders for delivery before 1902. Several of our local manufacturers are exceptionally busy on railway work in wagons, engines, and wagon fittings. There is also more doing in marine material, the shipbuilding yards of the North having recovered considerably from the slackness which was perceptible a month or two ago. Local establishments, which have gone energetically into electrical equipment work, are exceptionally well fixed, the demand being at present largely in excess of the powers of output. In some directions the collapse in South Africa owing to the war was rather a relief, as it enabled the makers to straighten matters with the home and colonial trade. They are looking forward now however, to the close of hostilities for the beginning of a very large and continually-increasing business in the Transvaal, the Orange River Colony, Natal, Cape Colony, and adjoining territories. There is no doubt the machinery in the mines will be found generally in a state requiring extensive repairs, if not indeed actual replacing by new plant. Great preparations are being made to meet orders, which it is believed, will come in the nature of a "boom." High expectations are entertained, too, in regard to the future permanent development of these countries under proper administrative and fixed arrangements.

The quietude previously noticed in the steel trade has not altered. Local manufacturers of Bessemer and Siemens steel report that they are well employed, but do not find new orders coming to hand to replace those they are now working upon. Quotations continue unchanged, manufacturers stating that they are still being supplied with fuel under contracts made at the long prices which prevailed at the middle of the year. So long as these are running they can make no concessions to customers. The key of the trade is therefore in the hands of the coalowners who have it in their power to relieve both the manufacturers and those dependent upon them. For the higher qualities of Bessemer steel the demand has considerably fallen off. Firms which "run" special markets are not so adversely affected as others.

It is announced that Mr. C. J. Stoddart, managing director of the Parkgate Iron and Steel Company, Limited, is to take the chairmanship of the board at the end of the present year. This change has been made at the wish of Mr. Stoddart, who desires to be relieved of part of the heavy responsibility devolving upon this well-managed company. Mr Dick, who has had extensive experience in the North, has been appointed general manager.

NORTH OF ENGLAND.

(From our own Correspondent.)

THERE can be no question that the depression in the iron and steel industries is becoming more pronounced every week, demand is slacker than ever, shipments decrease, stocks—so far as they are known—increase, operations are more irregularly carried on than for at least five years past, and prices move downward. There seems to be ample justification for the pessimistic views that are generally held about the future of trade, and producers are making up their minds to experience a period of dulness such as they have not had for several years. The only feature this week that will give satisfaction to anybody is the advance of wages given to the finished iron workers of the North of England—2½ per cent., to commence from last Monday. But that is no indication that the finished iron trade is improving; it is brought about by the trade that is past on orders which were booked when prices were at their best, and were only executed in the two months to which Mr. Waterhouse's return relates—September-October. As yet in no branch of industry in this district have wages been reduced; they remain higher than they have been for the last twenty-five years, though selling prices have dropped considerably since July—20s. to 30s. in finished iron and steel, 8s. 6d. in Cleveland iron, 9s. 6d. in hematite iron, 2s. 9d. in foreign ore, and 9s. in coke. This week alone all kinds of pig iron have fallen very substantially, as buyers are found with difficulty, which is only natural, for little iron has to be bought for early delivery, and no one will buy ahead when prices become every week more favourable to the consumers.

Competition is becoming very keen in the pig iron trade, as there is not now sufficiency of orders to take up the production, and stocks are once more increasing—it is not known how quickly in the hands of the makers, but in Connal's warrant stores the stock of Cleveland pig iron has been more than doubled since July, and on Wednesday night the quantity held was 23,028 tons, the increase for the month being 7587 tons. For the last week an average increase of 860 tons per day was reported. Considerable stocks of pig iron are accumulating in some of the furnace yards, and this is not a state of affairs that is appreciated by the makers, when it is taken into account that the winter season has not yet set in. They are thus pressing iron more freely on the market, with the result that prices go against them. Poor shipments and lessened consumption help to weaken the market.

It was expected that the shipments of pig iron to oversea destinations would decline, but it was hoped that this loss would to some extent be balanced by an increased demand on home account, particularly on Scotch. But deliveries on the latter account are distinctly disappointing, more particularly when it is borne in mind that Cleveland iron is offered at prices considerably cheaper than those ruling for Scotch iron. In the summer Cleveland warrants were quoted at 3s. 6d. per ton more than Scotch, this week the advantage is with the latter to the extent of 6s. 6d.; therefore the ebb has affected Cleveland warrants to the extent of 10s. per ton more than has been the case with Scotch. Cleveland iron can now be delivered to Glasgow founders at prices substantially below Scotch pig iron rates, but buying is at a discount, and everyone seems there, as here, to be waiting until the market is more settled, and the consumers can learn that the downward movement is approaching an end. At present all trade is of a retail character, no one buys who can avoid it.

The price of No. 3 Cleveland G.M.B. pig iron for prompt f.o.b. delivery has fallen this week to 63s. per ton, this being 1s. 6d. per ton less than the quotation which was generally made last week, and the aggregate fall from the best is now up to 8s. 6d. per ton, and the figure is lower than has been reported previously this year. No. 1 can be bought at 64s. 6d., it is only 1s. 6d. dearer than No. 3, whereas the ordinary difference is half-a-crown. No. 4 foundry is sold at 62s., grey forge at 60s., and mottled and white at 59s. 6d.

Hematite pig iron, after being steady for about a fortnight at 79s. per ton for mixed numbers, has recommenced to decline, and has lost 1s. 6d. this week, or 9s. 6d. in all since prices began to fall. The f.o.b. early delivery price for mixed numbers is now 77s. 6d. The output of hematite pig iron in this district has been considerably reduced, an evidence of which is the great decrease in the imports of foreign iron ore. Comparatively few sales of foreign ore have been made during the last few weeks, and the prices have steadily declined, until now Rubio ore can be had readily at 19s. per ton, delivered at the wharf in this district, and some merchants will accept even less. Gellivare iron ore for next year's delivery has been reduced 9d. per ton, the figures asked being 16s. to 21s. 3d. per ton, delivered at East Coast ports.

The decrease in shipments of pig iron from the Cleveland district is very marked, especially on oversea account. This month 75,434 tons have been exported, as compared with 83,695 tons last month, and 98,239 tons in November, 1899, all to 28th. It is not surprising that stocks in the public stores have this month been increased by 30 per cent., there being a larger increase than in any month this year. Exports of manufactured iron and steel have likewise fallen off very considerably—they have reached only 20,778 tons, against 27,373 tons in November, 1899, the decline being in manufactured iron.

For manufactured iron and steel the demand is reported to be exceedingly dull, and producers find it a difficult task to keep their mills running regularly. The output has fallen off considerably this month, and competition is keen in all branches, but more particularly among platemakers. American plates are being received by Tyneside shipbuilders, but none have yet been taken by those on the Wear or Tees. Some of the Wilson liners have brought both steel plates and steel billets, which have been supplied by the Carnegie Steel Works, Pittsburgh, the sea freight on which was £1 per ton, and even after paying that and the land-carriage on the other side, the cost to the British consumers was said to be less than the figures at which producers in this country offered them. German ship plates continue to be landed at yards both on the Tees and Tyne, and give entire satisfaction to the builders. Local plate makers maintain the price of iron and steel ship plates at £7 per ton, less 2½ per cent. f.o.b., but for steel boiler plates, which are usually £1 per ton above ship plates, the quotation is £9 15s.; and iron boiler plates are at £9 5s., both less 2½ per cent. f.o.t. Iron and steel ship angles are at £8, less 2½ per cent. f.o.t., while common iron bars are steady at £8, less 2½ per cent. f.o.t. Heavy steel rails would be sold at £6 net at works if a good order were offered, but small contracts could not be placed at so low a figure; indeed, £6 5s. to £6 10s. would have to be given, according to quantity.

The September-October return issued this week by Mr. Waterhouse to the North of England Finished Iron Trade Conciliation Board, showing the quantities of manufactured iron delivered, and the prices realised for that iron, was more favourable than might have been expected, for though quoted prices have been declining since July the realised prices have continued to advance as the manufacturers had old high-priced contracts to execute. As compared with the previous two months the average price showed an improvement of 3s. 6·69d. per ton, rising to £8 5s. 11·22d. per ton, this being the highest figure that has been attained during the last quarter of a century. It is 34s. 5d. per ton more than was reported in the corresponding period last year, and since prices began to rise about the middle of 1895, there has been a total appreciation of £3 11s. 10d. Rails during the last two months rose 7½d. per ton; plates, 4s. 8½d.; bars, 3s. 4½d.; and angles, 3s. 2d. In accordance with the sliding scale, wages at the mills and forges have been advanced from Monday last—puddlers 3d. per ton and others 2½ per cent. The following summary will be of interest at the present time.

Sales during the Two Months ending October 31st, 1900.

Description.	Weight invoiced. Tons cwt. qr. lb.	Percentage of total.	Average net selling price per ton. £ s. d.
Rails	725 10 2 12	3·39	7 16 8·02
Plates	6,583 5 1 25	30·52	7 10 10·51
Bars	10,417 4 2 11	48·65	8 19 4·67
Angles	3,784 0 0 27	17·44	7 16 6·60
	21,410 0 3 19	100·00	8 5 11·22

The firm of Walker, Maynard, and Co., Limited, has been launched this week to acquire and carry on the business of Walker, Maynard, and Co., at the Redcar Ironworks, Middlesbrough, and the Kilton Ironstone Mines in Cleveland. They also acquire the Coatham Ironworks. The capital is £240,000, divided into 160,000 6 per cent. preference shares of £1 each and 80,000 ordinary shares of £1 each, the latter being taken by the vendors as part payment of the purchase money. The business has been carried on since 1874 as a private partnership. The Redcar Ironworks consist of four blast furnaces in full operation, producing 115,000 tons of pig iron per annum. The Coatham Works at present are idle; they consist of two furnaces. The Kilton mines now produce 100,000 tons per annum. The annual average profits over the last three and a-half years have been £43,122, but in 1899 they reached £63,205, while over the last twenty-one years the average profit has been £22,579. The purchase price is put at £210,000.

The firm of R. Hood Haggie and Son, wire rope manufacturers, Willington and Newcastle, is to be registered as a public company. The business was established in 1789, and Mr. R. Hood Haggie, the head of the firm for forty-two years, will act as chairman and one of the managing directors, the other managing directors being Mr. Stevenson Haggie and Mr. Arthur J. Haggie.

The Leeds Steel Works, Limited, and Walter Scott, Limited, are to be amalgamated. The properties included are the Leeds Steel Works, at Leeds, and the Kelloe, Trimdon Grange, and Trimdon Collieries, in the county of Durham, besides cement and brick-works. Some of the shares will be offered to the public.

A report has been in circulation this week that the Government had decided to place their second arsenal at Manchester. Such, however does not appear to be the case, and traders here are hoping that the hopes raised some time ago that the banks of the Tees or Tyne will be chosen, will be fulfilled.

The North-Eastern Railway Company have nearly completed a branch line near Eaglescliffe Junction to connect what was known as the Leeds Northern with the mineral line from Hartburn to Thorpe Thewles, and over this they propose to run their fast goods traffic from the South to Sunderland and Newcastle, and so relieve the line near Stockton.

Messrs. Wm. Doxford and Sons, Pallion Shipyard, near Sunderland, have erected what is claimed to be the largest crane at any private shipyard. It will lift 150 tons at 50ft. radius, and 90 tons at 80ft. radius. Its total weight is 320 tons.

Messrs. Bolckow, Vaughan, and Co. are putting down for their Eston Steel Works a new electric light and power installation at a cost of £40,000.

The coal trade is quieter, and prices are being reduced, but they are still relatively a good deal dearer than those which consumers can get for their produce, and many of the latter blame the high prices of coal for hastening the depression which has come upon trade. Orders certainly are not so plentiful as they were, shipments are becoming less brisk, and some of the collieries are not kept in full operation. Best steam coals have been reduced to 15s. per ton f.o.b., and some has been done at less. Gas coals are also down, as are also other descriptions; indeed, the only one to maintain its position as regards value is the house-coal branch. Coke is declining in price steadily, and medium qualities can now be had at 20s., delivered at Middlesbrough furnaces. The Broomhill Collieries, Limited, have been formed, with an authorised capital of £350,000 in 6 per cent. preference and ordinary shares, and £325,000 of 4½ per cent. mortgage debentures, the object being to amalgamate the Broomhill and Radcliffe collieries, in Northumberland, to acquire the steamers belonging to the Broomhill Shipping Company, and the debenture stock of the Warkworth harbour. The output of the collieries last year was 638,000 tons.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market has been irregular this week, owing to speculative causes. On Monday Scotch warrants were very strong, and prices went up about 1s. per ton. The cause of this upward movement is reported to have been the purchasing of warrants by speculators to cover oversold accounts. When this operation was brought to a close on Tuesday afternoon, the market became very flat, and prices receded sharply, the former advance being more than lost. Business has been done in Scotch warrants from 69s. 3d. to 68s. 4½d. cash, and 69s. 7½d. to 68s. 5½d. one month, some iron also changing hands at 68s. 4½d. for delivery in twenty-four days. The business has been almost confined to Scotch warrants. Cumberland hematite is quoted 76s. 6d. to 76s. cash, and 76s. 3d. one month, while Cleveland warrants are nominally 63s. 6d. to 63s. 3d. cash.

Since last report one hematite furnace has been put out at Eglinton, while two additional furnaces have been placed on ordinary iron—one at Carron and one at Clyde Ironworks, and there are now 39 making hematite, 36 ordinary, and six basic iron. The total of 81 furnaces thus blowing in Scotland compares with 83 at this time last year.

There has been a further decline in the prices of the principal brands of Scotch iron, varying from 6d. to 1s. 6d. per ton. Govan, f.o.b. at Glasgow, No. 1, is quoted, 70s.; No. 3, 69s.; Carnbroe, No. 1, 71s. 6d.; No. 3, 69s.; Clyde, No. 1, 79s. 6d.; No. 3, 69s. 6d.; Calder, No. 1, 80s.; No. 3, 70s. 6d.; Gartsherrie, No. 1, 80s. 3d.; No. 3, 70s. 3d.; Summerlee, No. 1, 84s.; No. 3, 70s. 6d.; Coltness, No. 1, 87s.; No. 3, 70s. 6d.; Glengarnock, at Ardrossan, No. 1, 80s. 6d.; No. 3, 69s.; Eglinton, at Ardrossan or Troon, and Dalmellington, at Ayr, Nos. 1, 71s.; Nos. 3, 69s. 6d.; Shotts, at Leith, No. 1, 85s.; No. 3, 71s.; Carron, at Grangemouth, No. 1, not quoted; No. 3, 71s. per ton.

The shipments of pig iron from Scottish ports in the past week amounted to 5502 tons, compared with 6214 in the corresponding week of last year. Merchants report that the demand for shipping iron is of comparatively small account at the moment. The stock of pig iron in Glasgow warrant stores shows a reduction in the past six days of 200 tons, the total stock now amounting to only 72,925 tons.

There have been further arrivals of American pig iron into Scotland by way of the Continent to the extent of 2380 tons. The week's arrivals from the Cleveland district reached 6817 tons, being 1138 less than in the corresponding week of last year.

The demand for hematite pig iron has not been quite so pressing and Scotch prices are lower. Merchants now quote Scotch hematite pigs 82s. 6d. per ton for delivery in railway trucks at the steel works.

In most departments trade has been slackening, and this is the cause of a good deal of anxiety to firms that have of late been working on an extended scale and with heavy expenditure. The fear of a breakdown in business necessitating considerable sacrifices no doubt operates to induce not a few concerns to welcome proposals for combination. A group of rivet manufacturers has been brought together with the object of more economical and successful working. In the tube trade negotiations have been proceeding with the object of regulating output and prices.

The finished iron trade is easier, and work is difficult to obtain. Some firms have been obliged to discharge a considerable proportion of their workmen. The official accountant has certified that the average net price realised at works of manufactured iron in the West of Scotland in September and October was £8 11s. 4·49d. per ton, and upon this basis the wages of workmen have been reduced 5 per cent. from and after Monday last, and the rate of wages now in force will continue for the next two months.

Some new shipbuilding work is reported to have been placed with Clyde builders, including four large cargo steamers for Sir Donald Currie's African line.

Orders for steel material have been somewhat scarce in the past week or two, but at most of the works there is good employment in the meantime.

There is an easier tone in the coal trade, which is irregular in different parts of Scotland, both as regards supplies and prices.

The shipments of coals from Scottish ports are about 10,000 tons less than in the preceding week, and the current demand for export is not at all satisfactory. The state of the freight market would appear to indicate that very few orders are in hand for Mediterranean ports. The coalmasters have intimated that they will reduce prices 1s. per ton for splint coal during December, making the charge 13s., but they are not prepared to make a similar concession on small coal and dross, these being somewhat scarce. Household coals are also lower, and business for home consumption is active owing to colder weather.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

CARDIFF and Swansea export coal trade suffered last week from deficient tonnage, owing principally to the stormy weather. From Cardiff a fair quantity of steam coal was despatched to foreign coal stations, and to France, and one large cargo of 7000 tons to Colombo. France was also a large buyer of Swansea coal, taking more than the usual average.

Fluctuations have continued in price, and 20s. for best steam at Cardiff is becoming an ordinary figure. This week tonnage is coming in more freely, and it is by no means unlikely that house coal prices, which have been rather weak, may improve, and the slight decline in steam coal be stayed.

Mr. Abraham, M.P., "Mabon," has been giving the Welsh colliers his opinions upon coal prices and the coal trade. He states that "by some means or other the production of coal has increased. Mines that did not pay in dull times have been worked again, and the colossal dividends declared show that the output has been enormous. But while output has been rapidly overtaking the demand, the demand for home consumption especially has been checked—probably by the high price—that is natural. Still the winter season may help the demand again for some time. Beyond that there are no prospects of prices holding up to anything like their present position." "Mabon" concludes by remarking "that colliery proprietors and colliers have had a period of prosperity, and if they are prudent, both parties will treat a large part of their income in the one case, and wages in the other as exceptional, and place it to their reserve fund." From this it may be inferred that "Mabon" foresees a not distant decline in prices and wages.

December is expected to yield the colliers an advance of wages.

Another substantial coal contract has been entered into between the "P. and O." Company and leading coalowners of the Cardiff district for 300,000 tons to be delivered over 1901. Powell Duffryn secures 140,000 tons, Great Western collieries 50,000, Lewis Merthyr 50,000, and North Navigation 30,000 tons. The prices are not officially given, but are understood to range between 17s. 9d. and 19s. It is evident from this that the coals are not all of the best steam, but include probably seconds or Monmouthshire shipped from Cardiff.

Genoa continues to import large quantities of coal from Cardiff. On the 27th four cargoes left Cardiff for that destination, and on the same day out of a total of thirty steamers ten were bound for French ports. Steamers are increasing in number from America, but as a rule go out from Cardiff in ballast.

The Windsor Steam Coal Collieries soon promise to fall into line with the great South Wales collieries. The company was formed to lease for ninety-nine years the mineral properties of the Aber Valley. Two shafts, 19ft. in diameter, are being sunk. One is already down 500 yards, and the other over 370 yards, and it is expected that the 4ft. seam of steam coal will be won at a depth of from 600 to 620 yards. A large proportion of the surface work is ready, and excellent railway facilities arranged with Cardiff, Penarth, and Barry. This week there was a notification of an issue of 2900 cumulative preference shares, bearing interest at the rate of 10 per cent. The whole of the ordinary shares have been subscribed by the directors and their friends, and £20,100 of the preference shares. A company, principally London capitalists, is floating the Mynyddystwyn Collieries.

Coal business on 'Change, Cardiff, mid-week, was not very animated, and though best and seconds showed improvement, "drys" were weak, and lower prices were accepted. House coal was in moderate demand, though not so strong as desired, and for Monmouthshire, requirements, which have remained fairly good, continued. Quotations for small continue easier.

Latest quotations are as follows:—Best steam coal, 20s. to 21s.; seconds, 18s. to 19s.; drys, 17s. to 17s. 9d.; best small steam, 9s. 6d. to 10s.; seconds, 9s. to 9s. 3d.; inferior from 8s.; best Monmouthshire large, 17s. 9d. to 18s. 6d.; seconds, 16s. 9d. to 17s. 3d.; smalls, 8s.; best house, 22s. to 24s.; No. 3 Rhondda, 18s. to 18s. 6d.; brush, 16s. 6d. to 17s. 6d.; smalls, 13s. 6d. to 14s.; No. 2 Rhondda, 16s. 6d. to 16s. 9d.; through and through, 13s. 6d. to 14s.; smalls, 8s. to 8s. 6d.

Swansea coal prices:—Anthracite, finest hand-picked, 25s. to 26s.; seconds, hand-picked, 22s. to 22s. 6d.; best large, 20s. to 21s.; red vein, 16s. to 16s. 6d.; rubbly culm, 9s. 6d. to 10s. 6d.; steam coal, 20s. to 20s. 6d.; seconds, 17s. 9d. to 18s. 6d.; small, 8s. to 9s.; house coals, No. 2 Rhondda, 17s. to 17s. 3d. It will be noticed that the price of anthracite shows a slight falling off.

Both patent fuel and coke prices remain tolerably firm, only a small decline in price having taken place. Swansea prices are:—Patent fuel, 18s. 6d. to 20s.; coke, furnace, 26s. to 28s.; best foundry, 32s. to 34s. Cardiff prices:—Patent fuel, 21s. to 22s. 6d.; coke, furnace, 28s. to 29s.; foundry, 30s. to 32s.; and special foundry, 36s.

Pitwood is indicating an upward tendency. Latest prices Swansea, 20s. to 21s.; Cardiff quotations, 18s. to 19s. 6d.

This week outward freights, Cardiff, are more animated. Mediterranean rates are firmly maintained. Bay and coasting a little easier. Little inquiry for Plate and Brazil, and eastern business little doing.

The death of Mr. G. W. Pyman, of Whitby, is announced, father of the head of the Cardiff firm of Pyman, Watson, and Co.

The action of Mr. Richards, colliery proprietor, Swansea, against the Great Western Railway, which it was thought would have an important bearing on the Cockett tunnel, and possibly strengthen the probability of Swansea being placed on the main line, has come to an end, application of plaintiff being refused.

Forch Las mineral estate in the Avon valley was put up to auction this week at Cardiff by Stephenson and Alexander, and withdrawn at £12,000. It started at £5000.

The prominent topic of discussion in iron and steel circles is the increasing arrivals of American steel. Some difference of opinion exists. In the Swansea Valley it is stated that several important works which have been closed of late have done so principally on account of the American competition. On 'Change, Swansea, this week, a more hopeful view prevailed. Mid-week it was remarked, as a matter of fact, that several agents were present endeavouring to obtain orders for American bars, but did not meet with any marked success, an authority observing that the home-made article, which is superior and more trustworthy with regard to quality, was obtainable at a price which leaves no advantage to the importers of American make. The truth of the case would appear to be that if Welsh manufacturers and their men can take a common-sense view, and work rationally with each other in altering and adjusting the wage rate, the rivalry will cease. The article already turned out, but at a loss to the maker, is admittedly superior to the American. An important meeting of manufacturers and representatives of the men was held Tuesday evening at Swansea, when an effort was made to bring about an arrangement of this kind. The makers' point was to imitate the American system in "following the machinery." They want the output to be unrestricted, and to be enabled to produce more cheaply. The men argued on the old-fashioned basis, that restricting the output meant better prices and better wages. It was evident, however, that common-sense views are spreading, and in the end the representative agreed to recommend the men to work forty boxes per turn.

The West Australian Government placed this week an order for 10,000 tons steel rails with the Ebbw Vale Company. South African orders are also assuming prominence, and the substantial cargo sent last week promises to be the forerunner of others. A large cargo of rails left Newport, Mon., this week for Antwerp. The imports of the week included sleepers and pig from Harrington, and pig iron from Millóm. Large quantities of iron ore came in to the various ports, principally from Bilbao.

The tin-plate trade continues brisk. Last week the make was 64,838 boxes; shipments 58,052 boxes. Present stock 155,988 boxes. At Pontardawe a couple of mills are idle. At Foxhole the three mills are again at work. In the iron and steel centres there is moderate activity in rails, tram plates, and small goods.

On 'Change, Swansea, it is reported that marked reductions in stock of Glasgow pig and of hematite are taking place, but Cleveland shows an increase.

Closing prices are:—Glasgow warrants, 69s. 6½d., 68s. 11d., and 69s. 3d., cash buyers; Middlesbrough, No. 3, 63s. 7½d. to 63s. 9d.; hematite warrants, 75s. 3d. to 77s. for mixed numbers; Welsh bars, £8 7s. 6d. to £8 10s.; sheet iron and steel, £8 15s. to £8 17s. 6d.; steel rails, heavy, £6 5s. to £6 10s.; light, £7 5s. to £8 5s.; Bessemer steel, tin-plate bars, £5 5s. to £5 7s. 6d.; Siemens, best, £5 10s. to £5 12s. 6d., both firmer; tin-plates, Bessemer steel cokes, 13s. 6d. to 13s. 9d.; Siemens, 13s. 9d. to 14s.; ternes, per double box, 26s. 6d. to 29s. 6d.; best charcoal, 15s. to 16s.; big sheets for galvanising, 6ft. by 3ft. by 30 g., £11 10s. per ton; finished black plate, £10 to £10 5s.; Canadas, £13 to £14 10s.; block tin, £128 2s. 6d. to £127 7s. 6d.; lead, £17 7s. 6d.; spelter, £19 2s. 6d.; copper, Chili bars, £73 to £73 15s.

Good progress is reported with the Llanelly harbour works in connection with the new dock. The hydraulic engine is completed, one of the junctions with the Great Western Railway finished and opened, satisfactory work done with the coal hoists, and Messrs. Armstrong are about to put up travelling cranes. At a meeting this week it was decided to go to Parliament this session for powers to borrow £30,000 in order to complete the works.

There has been an expectation of a fall in coal shares, but little change can be recorded. Some have declined a trifle, others advanced a point or two. In rails there is a better inquiry for Taff ordinary, and quotations have been advanced ½. In work Ebbw Vale are improving, and this week again was ¼ better. Rhymney iron old, 42s. 6d.; Tredegar iron A, 9s.

The Cardiff Corporation had the subject of the Severn navigation and an improved waterway to Birmingham before them this week, when Alderman March proposed the following motion:—"That two members of the Council be appointed to support a joint deputation which has been formed to urge the Birmingham City Council to promote a Bill in Parliament for improving the navigation from Gloucester to Birmingham, such Bill to include the alteration of the Westgate Bridge at Gloucester." After a long discussion, a modified resolution was carried authorising a deputation to discuss the subject with the Birmingham authorities. At the meeting it was stated that the traffic is now so great between Cardiff and the Midlands that the railway authorities are not able to cope with it. The Westgate Bridge is the great obstacle, and until replaced with a swing bridge will remain so, and this Gloucester opposes strongly.

The Cardiff intercepting sewerage scheme, with an outfall at Lavernock, estimated to cost £189,000, was "carried" at a public meeting on Tuesday. The details of the scheme were ably explained by Mr. Harpur, engineer to the Corporation. Mr. Beasley, of the Taff Vale, and Mr. Lundie, of the Rhymney Railway, spoke in opposition.

NOTES FROM GERMANY.

(From our own Correspondent.)

NO change has taken place in the position of the iron trade since last week, the continual shrinkage in orders for both home and foreign consumption leaving considerable quantities of iron and steel to be disposed of at the works, and the result is that the tendency of prices shows increasing weakness. At the end of last month merchant bars had been offered in the Rhenish-Westphalian district at the basis price of M. 170 p.t., which was considered quite an exceptionally low price, but since then the steadily-decreasing activity in the various departments has caused quotations to move further downwards, and now M. 160 p.t., free place of consumption, is reported to have been taken in several instances. Silesian iron masters, having been fortunate in securing a fair amount of foreign orders, do not show the same willingness to accept lower rates. Russian orders are coming in pretty regularly now, and they will help to keep the ironworks in Silesia tolerably well occupied for some time to come. Quotations have been generally well maintained, M. 185 p.t. being present basis price for malleable iron bars, free place of consumption for Silesia and Posen, while M. 135 to M. 140 p.t. at works is being asked for foreign orders. It is, however, more than doubtful whether this price, which may be considered as favourable, can be maintained through winter. The output in crude iron is being limited to a considerable extent; the blowing in of new or repaired blast furnaces is to be postponed for the present, and the Donnermarkshütte is even reported to have blown out a blast furnace that was in blow for forty years. Silesian iron-masters expect these restrictions in output to prevent prices from going down too quickly. In October of present year 75,363 t. pig iron were produced in Silesia, which is the highest figure for this year. All the railway and engineering trades remain in lively and satisfactory occupation, and a change in a downward direction is not at all likely to take place, because there are so many home orders for axles, rails, hoops, and tires, &c., holding out. From America, too, contracts have again been coming in.

The Austro-Hungarian iron market shows very little life, all the mills and shops being but moderately occupied; girders have been pretty firm in price, while for bars a reduction was resolved upon.

Coal is much more easily obtainable on the Austrian market than formerly, the fear of a coal dearth in winter having caused consumers to cover their demand as early as possible, and now only small lots are required. Coke is still scarce, and so is coal for coke making. A fluctuating tendency in prices could be noticed for nearly all sorts of fuel.

Unfavourable accounts continue to come in from the Belgian iron market, the position of the iron trade in the Hainault district being particularly weak; some works stop on Monday and Tuesday every week, while others suspend operations altogether for a fortnight, now and then. That prices are wanting in firmness goes without saying. For bars and for girders 150f. p.t. is officially quoted, and plates No. 2 can be bought at 160f. p.t., French and German competition being very strong in the last-named article.

The Belgian coal trade is becoming a little more quiet, and prices are tending more in favour of the buyer. The ironworks have renewed their contracts in Flenu coal till February, 1901, at the basis price of 20·50f. p.t. for small coal, and 23f. p.t. for steam coal. House coal is as firm as ever.

The condition of the French iron market is the same as before, little business of importance having been transacted recently. The following figures, given by the *Rhenish-Westphalian Gazette*, show the production of pig iron in France, during the first six months of present year, to have been as under:—

	White forge pig. t.	Grey forge pig. t.	Total. t.
1900	1,079,108	262,880	1,341,988
1899	1,033,901	253,140	1,287,041
Increase for 1900	45,207	9,740	54,947

The highest production falls to the Meurthe et Moselle Departement, viz., 818,000 t., or more than 60 per cent. of the total output; then comes the Departement Nord with 156,000 t., Pas de Calais with 49,000 t., Saône et Loire with 42,000 t., les Landes with 41,000 t., Gard with 38,000 t., Loire Inférieure with 35,000 t., and Haute-Marne with 27,000 t.

The production of malleable iron was as follows:—

	Bars. t.	Plates. t.	Total. t.
1900	373,381	37,422	410,803
1899	375,032	44,631	419,663
Decrease for 1900	1,651	7,209	8,860

Concerning the different departments, output in the Departement Nord was 173,950 t.; Ardennes, 46,150 t.; Haute-Marne, 36,340 t.; Seine, 20,811 t.; Meurthe et Moselle, 20,208 t.; Saône et Loire, 16,691 t.; Loire, 16,285 t.; Allier, 9500 t.; Tura, 9200 t.

Production in steel was:—

	Rails. t.	Plates. t.	Other articles. t.	Total. t.
1900	146,803	162,931	351,508	661,242
1899	128,698	155,373	345,143	629,319
Increase for 1900	18,105	7,558	6,360	32,023

The largest output in steel falls to the Departement Nord, 145,363 t.; Meurthe et Moselle comes next with 127,459 t.; Saône et Loire, 54,021 t.; Loire, 47,597 t.; Pas de Calais, 40,923 t.; Loire Inférieure, 32,256 t.; Allier, 28,279 t.; Gard, 27,032 t.; Ardennes, 25,108 t.; les Landes, 24,380 t.; Haute-Marne, 19,194 t.; Oise, 17,827 t.; Nièvre, 13,905 t.; Morbihan, 10,683 t.; and other departments with less than 9000 t.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, November 21st.

THE report of the Commissioner of Navigation at Washington furnishes some information which in passing might as well be noted as showing the condition of American shipping. On June 30th the documented tonnage of the United States comprised 23,333 vessels of 5,164,839 gross tons, an increase of 300,000 tons over the previous fiscal year, which is almost wholly confined to the coasting trade, which is 4,338,145 tons. The foreign tonnage is 816,795 tons, comprised in 97 registered steamships of over 1000 tons, aggregating 260,325 tons. Single foreign steamship corporations own greater tonnage.

The export trade of the United States requires about 20 per cent. of the world's seagoing tonnage in foreign trade. The weight of iron exports by sea in 1899 was 24,000,000 gross tons, employing steadily 1200 steamships aggregating 3,600,000 gross tons and 1300 sailing vessels of 1,000,000 tons.

Our Southern cotton goods manufacturers are suffering from the exclusion from Chinese markets, whose normal cotton goods requirements absorb over 400,000,000 yards. Last year's exports were only 182,000,000 yards, of which one half went to China.

The American stock markets are very active. Stocks are selling beyond all previous experience; the demand comes from all sections of the country. Three-fourths of the buyers are buyers of stock for the first time. Prices are advancing, and the demand, now two weeks old almost, is surprising the market. There is also a spurt in industrial undertakings or enterprises, which have been lying dormant for months awaiting the outcome of the presidential contest. As the country has decided to not lapse into barbarism, and have four years of the Middle Ages conditions, enterprise feels warranted in asserting itself.

The demands for material and merchandise of all kinds is phenomenal. Even the distributors of dietary products, clothing, provisions, are overwhelmed with orders for quick delivery. Stocks of all kinds and everywhere had been permitted to run down all year, and since the election retailers have been rushing in orders as though it were absolutely necessary. There is some probability of a general appreciation of prices. The iron and steel makers are also enjoying a sudden boom for supplies, which have every indication of permanency in all lines, and with advancing prices. Mill products have advanced. Billets are 19·75 dols. at mill. Plates are being ordered in enormous quantities in view of higher prices. Steel rails are not selling because of the lack of confidence in present quotations. Makers insist the price may be advanced instead of reduced. Glowing reports come from all iron and steel centres. Extraordinary efforts are being made to reduce cost of delivering steel products abroad.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal market quiet, and prices for all descriptions are easier. Tonnage still keeps scarce. House coal market is quiet. Exports for week ending November 24th were:—Coal, foreign, 53,414 tons; coastwise, 15,622 tons. Imports for week ending November 27th were:—Iron ore, 10,082 tons; iron pyrites, 800 tons; pig iron, 1802 tons; scrap, 353 tons; cement, 180 tons; pitwood and mining timber, 6145 loads, and five cargoes deals, &c.

Coal:—Best steam, 18s. 6d. to 19s.; seconds, 17s.; house coal, best, 22s.; dock screenings, 9s. 6d.; colliery small, 7s. 9d. Pig iron:—Scotch warrants, 68s.; hematite warrants, 76s. 6d. f.o.b. Cumberland. Iron ore:—Rubio, 17s. 6d. to 18s.; Tafna, 17s. to 17s. 6d. Steel:—Rails, heavy sections, £6 5s. to £6 10s.; light ditto, £7 5s. to £8 5s., f.o.b.; Bessemer steel tin-plate bars, £5 5s. to £5 7s. 6d.; Siemens steel tin-plate bars, £5 10s. to £5 12s. 6d., all delivered in the district, cash. Tin-plates:—Bessemer steel, coke, 13s. 6d. to 13s. 9d. nominal; Siemens, coke finish, 13s. 9d. to 14s. nominal. Pitwood, 19s. to 19s. 6d. ex ship. London Exchange telegram:—Copper, £72 13s. 9d.; Straits tin, £127 15s. Freights firm.

CATALOGUES.

The Bedford Engineering Company, Bedford. Illustrated price list of steam cranes.

John Spencer, Limited, Wednesbury. New and revised edition of iron and steel tubes, valves, and tools.

The Electric Power Transmission Company, Edmund-street, Birmingham. Preliminary specification of steel-clad motors and switches.

Robert Boby, Union-court, Old Broad-street, London. Illustrated pamphlet of the Chevalet-Boby heater detartariser for softening and heating feed-water.—Many sizes of the apparatus are shown, capable of treating from 200 to 1600 gallons of water per hour.

Holden and Brooke, Limited, West Gorton, Manchester. Abridged catalogue of steam users' specialities, including injectors, ejectors, steam valves, cocks, and water gauges.—Some information and tables given in the little pamphlet may be found useful to purchasers in the choice of an injector.

Wheatley Kirk, Price, and Co., Queen Victoria-street, London. Catalogue of their sale, by public auction, of electrical and other modern plant and machinery, to be held at the works lately occupied by the Aluminium Company, Oldbury, near Birmingham, on the 5th December.—The book contains plates prepared from photographs of the machinery, also reproductions of indicator diagrams taken from the engines themselves. As a catalogue of a sale by public auction of engineering plant and machinery this is claimed to be unique.

IT is stated that Mr. G. L. Watson, of Glasgow, has been commissioned by the German Emperor to design a racing cutter to be an improved Meteor. A start in her construction is to be made immediately.

AUSTRALIAN NOTES.

(From our own Correspondent.)

A SYNDICATE has been formed in New South Wales for the establishment of an iron and steel works, and is depositing £10,000 with the Government in proof of its *bonâ fides*. The Premier has undertaken to place all orders for steel rails with the company at a price slightly above the rate ruling in the home markets, including freight. It is understood that the site for the works is to be at Port Kembla, in the Illawarra district.

Several spasmodic efforts have been made from time to time to establish ironworks in the Colony, but sufficient financial support has not previously been given, nor has the outlook been very promising. Now that federation has been accomplished, the aspect of affairs has been altered, and it is now a race who can be first in the field.

The syndicate in the Wallerawang district is still buying in large tracts of lands, covering not only ore deposits, but coal and limestone. No attempt has yet been made to work these, and it is understood the company is waiting for further capital from England.

In Queensland a Bill is before Parliament to authorise the construction of a private line of railway by the British Colonial Railways Corporation, Limited, from Port Norman to Cloncurry, for the purpose of opening up large iron deposits which the Government Geologist declares is there in abundance.

For the encouragement of the industry in New Zealand, the Government there is offering a bonus of £1 per ton on the first 20,000 tons of marketable iron or steel produced by a company formed with a capital of not less than £200,000, and that the iron and steel required by the Colony shall be taken from the company at a margin above the market rates ruling beyond the Colony, allowing freights.

In Tasmania a special effort is being made also, the Blyth Iron Mines, Limited, having secured the services of Mr. J. H. Darby, managing director of the Brymbo Steel Company, Middlesbrough, who is to give expert advice on the erection of smelters and the best method of treating the ore.

A net increase of £20,463 is shown in the earnings of the New South Wales railways for the quarter ending September 30th last, as compared with the corresponding period of last year.

LAUNCHES AND TRIAL TRIPS.

WILLOWDENE, steel cargo steamer; built by. R. Craggs and Sons; to the order of, The Dene Steam Shipping Company, Limited; dimensions, 360ft., 48ft., 30ft. 10in.; to carry, 6800 tons deadweight; engines, triple-expansion, 25in., 40in., 68in., by 48in., pressure 180 lb.; constructed by, Sir C. Furness, Westgarth, and Co., Limited; launch, November 23rd.

WOODBURN, steel screw steamer; built by, The Blyth Shipbuilding Company, Limited; to the order of, The Tyne and Blyth Steamship Owning Company, Limited; dimensions, 313ft. 6in.; engines, triple-expansion. 22½in., 37in., 61in., by 39in. stroke, pressure 180 lb.; constructed by, Thos. Richardson and Sons, Limited; trial trip, November 22nd.

GERMANICUS, steel screw steamer; built by, Ropner and Son, Stockton-on-Tees; to the order of, C. Anderson, Esq., of Hamburg; dimensions, 363ft., 49ft., 29ft. 9in.; to carry, about 6200 tons deadweight; engines, triple-expansion, 25in., 42in., 68in., by 45in. stroke, pressure 180 lb.; constructed by, Blair and Co., Limited; launch, November 23rd.

CONWAY, steel screw steamer; built by, Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of, Sir C. Furness for L. and P. Conner and Co., West Hartlepool; dimensions, 360ft., 47ft. 9in., 30ft. 2¼in.; engines, triple-expansion, 25in., 41in., 67in., by 45in. stroke, pressure 165 lb.: constructed by, Wm. Allan and Co., Limited; launch, November 23rd.

FLORICAN, turret steamer; built by, W. Doxford and Sons, Limited, for the Burrakur Coal Company, Limited, Calcutta; dimensions, 342ft., 46½ft., 47½ft.; to carry, 6100 tons deadweight; engines, triple-expansion, 23ft., 40ft., 66ft. by 42in., pressure 200 lb.; to carry coal from Bengal to other ports on the Indian Coast, and even outlying ports in the Indian Ocean; launch, November 21st.

ELLENIA; built by, Northumberland Shipbuilding Company, Limited; to the order of, Lorenzo Kosovic and Partners, Trieste; dimensions, 372ft., 48ft., 30ft. 10in.; engines, triple-expansion, 24½in., 40in., 68in., by 48in., pressure 180 lb.; constructed by, North-Eastern Marine Engineering Company, Limited; trial trip, 22nd November.

PECINE, steel screw steamer; built by, Craig, Taylor, and Co.; to the order of, Luigi Cosulich, Esq., of Fiume; dimensions, 299ft., 43ft., 21ft. 3in.; engines, triple-expansion, 21in., 35in., 57in., by 39in., pressure 160 lb.; constructed by, Sir C. Furness, Westgarth, and Co., Limited; trial trip, November 23rd; 11½ knots.

ASSYRIA, steel screw steamer; built by, David and William Henderson and Co., Limited; to the order of, The Anchor Line, Limited; dimensions, 470ft., 55ft., 33ft.; engines, triple-expansion, 29½in., 47in., 78in., by 54in.; launch, November 26th.

TRADE AND BUSINESS ANNOUNCEMENTS.

MR. JOSEPH HAMBLET, engineering works and foundry of West Bromwich, is opening London offices at 110, Cannon-street.

THE Scotia Engine Works, Sunderland, have been amalgamated with the firms of Thomas Richardson and Sons, Limited, Hartlepool, and Sir Christopher Furness, Westgarth, and Co., Limited, Middlesbrough, and will henceforth trade under the style of Richardsons, Westgarth, and Co., Limited. All business in connection with these works will be conducted at the Sunderland office as before.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

**** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

14th November, 1900.

20,542. TROUSER HANGERS, L. F. L. Pynchon and E. M. Mahl, London.
20,543. FILTERS, J. E. Charon and P. Astrue, London.
20,544. SEPARATING PARAMAGNETIC MATERIAL, E. Gates, London.
20,545. FASTENERS for BOOT UPPERS, H. H. Lake.—(*W. E. Ellis, United States.*)
20,546. HOLDING PNEUMATIC SEALING CUPS, J. Kroog, London.
20,547. PLAYING NAVAL WAR GAMES, N. B. Hill, London.
20,548. SCREW MACHINES, A. Verktygsmaskiner, London.
20,549. ADDRESS HOLDER APPLICABLE to BAGS, E. Nixon, London.
20,550. HARVESTERS, W. Foxton, London.
20,551. CUTTING GREEN CLOVER VETCHES, W. Foxton, London.
20,552. APPARATUS for DRYING HAIR, K. H. Balke, London.
20,553. STEAM GENERATOR, La Société Solignac Grille and Cie., London.
20,554. BEDCLOTHES-ADJUSTING DEVICE, C. J. Wade. London.
20,555. APPARATUS for CLEANING GRAIN, R. Simon, London.
20,556. WATER HEATER, S. Ewart and W. H. Bennett, London.
20,557. APPARATUS for COMPRESSING GAS, C. S. Snell, London.
20,558. ELECTRIC BELL CIRCUITS, The Berlinger Telephone Manufacturing Company.—(*J. Berline, Germany.*)
20,559. FOOD WARMER for SICK-ROOMS, P. M. Bishop, London.
20,560. MATCH HOLDER, G. W. Paton and The Diamond Match Company, Ltd., London.
20,561. FURNACES, R. Schulz, Liverpool.
20,562. DOUCHES, P. E. Kathe, Liverpool.
20,563. JACQUARD MACHINES, R. H. S. Reade, T. Orr, F. Morton, and W. R. Gilpin, Manchester.
20,564. PROOFING of TEXTILE FABRICS, C. Baswitz, Manchester.
20,565. PRESSING LINOLEUM, C. H. Scott, London.
20,566. PLUMBING, R. J. Sayers and A. C. Smith, London.
20,567. APPARATUS for PURIFYING CASKS, H. Hill, London.
20,568. CALCINED BASIC SUPERPHOSHATE, G. H. Hughes, London.
20,569. SASH FASTENERS, M. McConnell, London.
20,570. CIGARETTES, W. E. Allwood, London.
20,571. PNEUMATIC CRUTCHES, A. A. Rickard, London.
20,572. DRYING MOULDED BRICKS, P. O. von Krottnaurer, London.
20,573. ELECTRIC CONTROLLERS, W. H. Harfield, London.
20,574. GAS WASHERS, L. Hersey, London.
20,575. FURNITURE-PACKING CASE, H. Lebus and S. Shirtcliffe, London.
20,576. SIGNALLING APPARATUS, J. A. Fleming and Marconi's Wireless Telegraph Company, Limited, London.
20,577. TURBINES, G. M. Gibson, London.
20,578. BALANCING of STEAM ENGINES, J. M. Gray, London.

15th November, 1900.

20,579. OBLITERATING ENGRAVED MATTER, W. H. R. Kelly. London.
20,580. TOOL HOLDER, C. Moon, Stoke-on-Trent.
20,581. CYCLE TOOL BAG, A. J. Adams, London.
20,582. BURNING METHYLATED SPIRITS, J. Templeman, London.
20,583. CLEANING STEEL, S. Cowper-Coles, London.
20,584. WELT-OPENING DEVICE, J. Gimson, Leicester.
20,585. HOT-WATER APPARATUS, S. D. Williams, Newport, Mon.
20,586. COMPOSITION for FIRE-GRATES, T. M'Guinness, Bradford.
20,587. STEAM SLIDE VALVE GEAR, J. Weir and G. and J. Weir, Limited, Glasgow.
20,588. INCANDESCENT GAS BURNERS, F. Coe, Derby.
20,589. LADIES' SKIRTS, J. H. Thraves, Nottingham.
20,590. CARRIERS for PORTABLE ELECTRIC CABLES, R. Smith, Birkenhead.
20,591. GUIDE for FISHING REELS, A. J. Rudd, Norwich.
20,592. "READY TEA," J. S. Derbyshire and R. L. Lever, Nottingham.
20,593. GRATES for STEAM BOILERS, R. Johnson, Southport.
20,594. SKIRT EDGING, J. Hall and A. H. Pearson, Manchester.
20,595. SWIFT-HANK DYEING MACHINES, A. B. Burrows, Halifax.
20,596. BRAKE for FISHING REELS, A. J. Rudd, Norwich.
20,597. COIN-FREED MACHINES, A. Forbes, Glasgow.
20,598. RUBBER TIRE WHEELS for VEHICLES, F. Pope, Dublin.
20,599. APPARATUS for DESICCATING MATERIALS, J. Murrie, Glasgow.
20,600. FLUE and BOTTLE BRUSH MACHINE, F. J. Pell, Northampton.
20,601. SECURING CORKS in BOTTLES, S. Brick, Halifax.
20,602 ENGRAVING MACHINES, W. H. Lock and M. Batt, London.
20,603. POCKET PROTECTOR, F. Fletcher, Leeds.
20,604. TOBACCO PIPE, W. Horrigan, London.
20,605. DEVICE for USE with GRATE REGISTERS, E. H. Pearce, London.
20,606. RAILS, J. H. Trail, London.
20,607. SCORING BILLIARD GAMES, W. G. Honey, London.
20,608. ROLLING TUBES, J. Addicott, London.
20,609. CYCLE FORKS, G. W. and E. F. Goodyear, Birmingham.
20,610. TYPEWRITING MACHINES, J. S. Foley and J. H. Birch. London.
20,611. STRETCHING ARTICLES of CLOTHING, O. Müller, London.
20,612. QUICK TANNING PROCESS, C. Brant, London.
20,613. ILLUMINATION DEVICE, F. de Mare, London.
20,614. HORSESHOES, H. Schlüter, London.
20,615. DRIVING GEAR for CYCLES, E. Willemart, London.
20,616. FURNACES, A J. Liversedge, London.
20,617. POTATO WASHER, E. Mayman, London.
20,618. FURNACES, J. W. Stock, London.
20,619. COMPUTING SCALE, C. A. Allison.—(*The De Vilbiss Computing Scale Company, United States.*)
20,620. CLOTH-WINDING MACHINES, B. Anderson, London.
20,621. SHIPS' ANCHORS, J. Verity, Liverpool.
20,622. TROUSER STRETCHER, B. Draper, Liverpool.
20,623. SELF-DETACHING HOOKS, E. G. Weddell, J. G. Chamberlain, and R. Player, London.
20,624. TIMEPIECES, A. Steyert, London.
20,625. STERILISATION of LIQUIDS, J. Kroog, London.
20,626. SHIRT COLLAR STIFFENERS, E. R. Gould, London.
20,627. ENDLESS CONVEYORS, T. R. Murray, Melksham, Wilts.
20,628. CLEANING STEAM GENERATORS, La Société Solignac Grille and Cie., London.
20,629. STEAM GENERATOR, C. J. A. Grille, London.
20,630. CONVERTIBLE BRACES, L. N. Dyhrberg and G. K. Askin, London.
20,631. AUTOMATIC ELECTRIC CARRIAGES, H. Dubs and L. Lafitte, London.
20,632. SHOE POLISHER, W. Duns, London.
20,633. CARDBOARD BOXES, W. T. Pretty, London.
20,634. BRICKS, S. J. Payne and F. S. Taylor, London.
20,635. PRESERVATION of BUTTER, J. A. Roelofsen, London.
20,636. VALVES for WATER-CLOSETS, D. T. Konney, London.
20,637. BICYCLE LOCK, M. Longden, Bromley, Kent.
20,638. ROPE CLIPS, B. R. Adkins, London.
20,639. ARTIFICIAL STONE, W. Dünkelberg, London.
20,640. CLOTHES RECEPTACLES, N. D. Spencer, London.
20,641. DEEP SEA MEASURING INSTRUMENTS, A. C. Larson, London.
20,642. SASH FASTENINGS, C. G. Redfern.—(*A. Schneider, Germany.*)
20,643. LOCKING WHEELS of CYCLES, E. Eschmann, London.
20,644. TREATING ORES, P. J. Ogle and H. J. Carson, London.
20,645. HEATING STEAM, J. A. E. M. P. B. O'Brien, London.
20,646. WRITING SLATES, G. Harrison.—(*C. Giese, Germany.*)
20,647. FITMENTS for CHALLENGE CUPS, G. S. C. Swinton, London.
20,648. PNEUMATIC TIRES for VEHICLES, J. Quednau, London.
20,649. HORNS for RECEIVING SOUND, J. R. Challen, jun., London.
20,650. RAIL BOND, G. C. Marks.—(*L. W. Southgate, United States.*)
20,651. LARYNGOSCOPIC LAMP, W. Avery and A. Burrell, London.
20,652. SCAFFOLDING, H. A. Röder, London.
20,653. ACETYLENE GAS APPARATUS, R. Rée, London.
20,654. BUFFER DEVICES for TRAMCARS, W. J. Moore, Liverpool.
20,655. CALLENDAR CARDS, &c., W. Osterhorn, Liverpool.
20,656. STERILISING BEER, E. Berliner and A. Herbert, Liverpool.
20,657. MOULDING PRESSES, &c., H. A. E. Smith, London.
20,658. ALARM for BAGS, B. Bloom and L. Meyer, London.

16th November, 1900.

20,659. POLEHEADS, A. M. Young. London.
20,660. RENDERING IRON MALLEABLE, S. Cowper-Coles, London.
20,661. COUPLING APPARATUS for RAILWAY VEHICLES, A. Wren, Southampton.
20,662. COVER for HANDLES of BRAKES, C. Symes, Liverpool.
20,663. REFLECTING ELEVATING PEEP-SIGHTS for RIFLES, R. C. Woodville, London.
20,664. INSTRUMENT for LADIES' SKIRTS, H. L. Saxty, Bristol.
20,665. FASTENERS for BOOTS, M. J. Adams, Leeds.
20,666. LIFE-GUARD for HORSELESS VEHICLES, M. Cohen, Manchester.
20,667. STRAIGHTENING and TEMPERING SAWS, J. Brailsford, Sheffield.
20,668. REPAIRING the COVERS of PNEUMATIC TIRES, J. Collins, London.
20,669. IGNITING COAL GAS, S. Hey.—(*A. Wauters, Belgium.*)
20,670. CYCLE RICKSHAS, J. Marston, Limited, and J. H. Herbert, Wolverhampton.
20,671. INDICATING FLOW of WATER, W. E. Astley, Manchester.
20,672. MARINE ENGINE GOVERNOR, D. T. Scott, Manchester.
20,673. RIM BRAKE for CYCLES, W. Travers, Wolverhampton.
20,674. PUBLIC WASH-HOUSES, D. K. Tullis, Glasgow.
20,675. BICYCLES, A. M. Westland, Birmingham.
20,676. MANUFACTURE of NITRATE of AMMONIUM, J. B. Aitken.—(*F. Daub, Holland.*)
20,677. OIL BURNER, C. L. Lamare, London.
20,678. DOOR LOCKS and LATCHES, D. Waine, Birmingham.
20,679. COIN-FREED LOCKS for DOORS, W. E. Hipkins, Birmingham.
20,680. PROTECTING DRAWINGS, A. Maxwell, Bearsden, near Glasgow.
20,681. REMOVING SLUDGE, J. Ashton, Ormskirk, Lancs.
20,682. STORAGE of MERCHANDISE, R. E. Leetham, Manchester.
20,683. PULLEYS, J. W. Knowles, H. Barker, and J. Dean, Bradford.
20,684. BOTTLE STOPPER, J. Bannerman and D. Miller, Arbroath.
20,685. TREATING MILK, F. J. Lloyd, W. Thorp, and W. Weddel, London.
20,686. KITCHEN RANGES, S. R. Twist, London.
20,687. SURVEYING ROADS, R. Jones and D. D. Esson, London.
20,688. PARING MACHINES for POTATOES, E. Geneux, London.
20,689. RUBBER TEATS, M. D. Armstrong and J. Dowell, London.
20,690. MAKING COMPOUND WINES, F. S. Needham, London.
20,691. DELIVERING GOODS, G. J. Morgan and G. Tillotson, London.
20,692. TEA KETTLES, J. Robinson and J. E. Watson, Ipswich.
20,693. RANGE FINDER, W. A. Burns, F. N. Baker, and J. Lena, Nuneaton.
20,694. PNEUMATIC TIRES for CYCLES, H. S. Groves, London.
20,695. EXAMINING INTERIORS of CASKS, F. Hughes, London.
20,696. LIFE GUARDS for TRAMCARS, &c., P. Fisher, Dundee.
20,697. PETROLEUM OIL BURNERS, B. W. Winterflood, London.
20,698. TREATMENT of FIBRES, F. Paternoster, London.
20,699. METALLIC MATTRESSES, H. W. Campbell, Liverpool.
20,700. DYEING and PRINTING APPARATUS, C. D. Abel.—(*Actien-Gesellschaft für Anilin-Fabrikation, Germany.*)
20,701. MAKING MAPS, H. Henrijean and A. Patesson, London.
20,702. EXTRACTION of COPPER, T. A. Irvine, London.
20,703. ALARMS, A. E. Hall and H. de M. Wellborne, London.
20,704. CYCLE CLIP, A. E. Hall and H. de M. Wellborne, London.
20,705. CYCLE RIMS, T. H. Woollen and F. Waters, London.
20,706. LITHOGRAPHIC PRINTING MACHINE, E. Milne, London.
20,707. ELECTRIC EXERCISING MACHINE, M. B. Ryan, Cologne.
20,708. FEET PROTECTOR, G. L. Lavington, C. J. Axten, and W. T. Hall, London.
20,709. HOLDING GATES and DOORS, L. Fletcher, London.
20,710. PHONOGRAPHS, W. P. Thompson.—(*F. Myers and H. Smythe, United States.*)
20,711. SHOW CASES, W. P. Thompson.—(*B. B. Goldsmith, United States.*)
20,712. FURNACES, W. P. Thompson.—(*F. W. Braun, United States.*)
20,713. CRUSHERS for ORES, W. P. Thompson.—(*F. W. Braun, United States.*)
20,714. FASTENER for CUFFS, K. Kirchberger, Liverpool.
20,715. PRODUCTION of CASTOR BOWLS, T. Smith, Birmingham.
20,716. PRODUCTION of CASTOR BOWLS, T. Smith, Birmingham.
20,717. CIGAR and CIGARETTE CASES, J. W. Stevenson, London.
20,718. NEW COLOURING MATTERS, B. Willcox.—(*Badische Anilin and Soda Fabrik, Germany.*)
20,719. COLOURING MATTERS, B. Willcox.—(*The Badische Anilin and Soda Fabrik, Germany.*)
20,720. ROTARY ENGINES, P. G. Servaes, London.
20,721. LAWN RAKES, I. M. Phillips, London.
20,722. VEHICLE BRAKES, G. Hiltenbrand, London.
20,723. TIE and COLLAR CLIP, E. Couch, London.
20,724. SWEEPING and ROLLING APPARATUS, F. E. Goldsmith, London.
20,725. VARNISH, H. H. Lake.—(*R. A. Worstall and C. F. Hackathorn, United States.*)
20,726. MECHANICALLY WASHING SAND, C. H. Regnard, London.
20,727. HERMETIC SEALING of RECEPTACLES, J. R. Croft, London.
20,728. TIN OPENERS, I. George, London.
20,729. MANUFACTURE of FABRICS, R. B. Ransford.—(*L. Cassella and Co., Germany.*)
20,730. PACKING TEA, H. Parkes and R. J. Bainbrigge, London.
20,731. PORTABLE SCAFFOLDINGS, J. Croft-Smith, London.
20,732. CONSTRUCTION of STAIRCASES, A. R. Robinson, London.
20,733. PRODUCING CELLULOID-LIKE PRODUCTS, E. Zühl, London.
20,734. HAND LOOMS, R. Flower, London.
20,735. LIQUID-SELLING APPARATUS, J. C. H. Ellehammer London.

17th November, 1900.

20,736. BRACKET SCREW for CYCLES, A. Burgess, Malvern.
20,737. CLASP for SHUTTLE PEGS, H. Milner and S. Firth, Yeadon, Yorks.
20,738. MAGIC LANTERNS, A. G. Manifold, New Brighton, Cheshire.
20,739. DRESS SKIRT SUPPORTER, H. Horsley, Manchester.
20,740. SPRING MATTRESSES, T. Mellor, Glossop.
20,741. KNITTING MACHINES, G. Sowter, W. I. James, and W. H. Dorman and Co., Limited, Stafford.
20,742. CIRCULAR KNITTING MACHINES, G. Sowter, W. I. James, and W. H. Dorman and Co., Limited, Stafford.
20,743. VENTILATION of WATER-CLOSETS, C. Evans, Manchester.
20,744. COMBINED RIFLE and WIRE CUTTER, H. Hallows, Manchester.
20,745. ARITHMATIC-TEACHING DEVICE, J. Kellett, Manchester.
20,746. HANDLING BARRELS, J. Elliot and W. Liggins, Coventry.
20,747. MACHINE for PLANING METAL, A. E. Allison, Middlesbrough.
20,748. APPARATUS for FOLDING PAPER, M. E. Macauley, Glasgow.
20,749. CYCLE BRAKES, J. Taylor, London.
20,750. BROOCHES, J. F. Sumner, Birmingham.
20,751. FIRE BRIDGES for FURNACES, W. G. Potter, London.
20,752. DESIGNS for ADVERTISING, J. Whitehead, Birmingham.
20,753. ATTACHING ADDRESS LABELS, H. G. Irwine, Liverpool.
20,754. TOBACCO, A. Grundy, Liverpool.
20,755. MACHINES for DRYING YARN, B. Cohnen, Manchester.
20,756. TREATING CO-ORDINATION in TABES, C. Tisell.—(*L. Vorstädter, Russia.*)
20,757. GENERATING ELECTRIC CURRENTS, E. van Haanen, Manchester.
20,758. GENERATING ELECTRIC CURRENTS, E. van Haanen, Manchester.
20,759. INTERNAL COMBUSTION ENGINES, H. Schwarz, Manchester.
20,760. SHIPS' LIGHTS, J. Shaw and J. Grantham, Wellington-on-Tyne.
20,761. ELECTRICAL CELLS, D. F. B. Cotes, Burton-on-Trent.
20,762. COVERING of PULLEYS, J. Fraser, Glasgow.
20,763. RAISING WINDOWS, M. G. Kelso and G. D. R. Douglas, Glasgow.
20,764. INCANDESCENT ELECTRIC LAMPS, A. A. Guest, Birmingham.
20,765. HOLDERS for ELECTRIC LAMPS, C. W. Kemp, Birmingham.
20,766. CHEESE PRESS, J. Campbell, Glasgow.
20,767. VALVES, G. Cockburn, Glasgow.
20,768. HORSESHOE CALKS, W. Ross, Glasgow.
20,769. CABLE HANGER, J. D. Brunton, Glasgow.
20,770. AIR-COOLING DEVICE, K. Heimpel, Berlin.
20,771. THERMOMETER CASE, H. Frank, Berlin.
20,772. GRINDING MACHINE, H. Hemmeter, Berlin.
20,773. SYSTEM of HEATING BOILERS, U. Mantrant, London.
20,774. APPARATUS for COOLING WATER, W. Sayer, Derby.
20,775. PNEUMATIC TIRES, E. and J. Walster, London.
20,776. ROLL CAMERA, J. A. Pautasso, London.
20,777. COIN-FREED MACHINES, W. H. Stacpoole, London.
20,778. ELECTRIC ARC LAMPS, J. A. Heany, London.
20,779. ELECTRIC ARC LAMPS, J. A. Heany, London.
20,780. CARTRIDGE BELTS or HOLDERS, A. Meyer, London.
20,781. COLLAPSIBLE CHAIRS, F. Vogel, London.
20,782. SPINNING MACHINES, F. Hodgson and F. Spence, Halifax.
20,783. PADLOCKS, G. B. Melvill, Manchester.
20,784. PRINTING PIECE GOODS, S. Bowden, Manchester.
20,785. STRAP FASTENER, W. T. McFarlane, Manchester.
20,786. SAND MOULDS, J. Ferguson and R. H. Stephenson, London.
20,787. DRIVING BELTS, G. Müller, London.
20,788. SIMULTANEOUS PRODUCTION of SEVERAL PHOTOGRAPHIC PICTURES, C. H. E. A. Miethe, Liverpool.
20,789. PROJECTING PHOTOGRAPHS, C. H. E. A. Miethe, Liverpool.
20,790. THRESHING MACHINE FEED APPARATUS, W. Schäfer, Liverpool.
20,791. TABLE DEVICES for SICK BEDS, W. Schleuning, Liverpool.
20,792. FILLING CARTRIDGE CASES, N. Celpek, London.
20,793. FASTENING DEVICES for BUTTONS, J. E. Plator, London.
20,794. FUEL ECONOMISER, L. Schramm, Westcliff-on-Sea.
20,795. SASH LOCKS and BURGLAR ALARMS, J. G. Moser, London.
20,796. DRIVING MECHANISM for BICYCLES, J. Küster, London.
20,797. SOUND-MAGNIFYING APPLIANCES, O. Rieger, London.
20,798. MOULDS for CASTING, J. Cox, London.
20,799. SAFETY EXPLOSIVE, R. Kindler, London.
20,800. PRIMER for PRODUCING IGNITION by ELECTRICITY, R. Kindler, London.
20,801. SOLUTION of CELLULOSE, J. Imray.—(*E. Bronnert, M. Frémery, and J. Urban, Germany.*)
20,802. PRISMATICALLY RIDGED TRANSPARENT SHEETS, M. F. Ewon, London.
20,803. WATERPROOFING WAX VESTAS, J. S. Studley, Bangor.
20,804. TRAVELLING FURNACE BARS, W. G. Potter, London.
20,805. SHARPENING RAZORS, A. van Kan, London.
20,806. DECORTICATING MACHINES, F. A. Billioud, London.
20,807. SUPPLYING FUEL to FURNACES, The Central Cyclone Company, Limited.—(*J. C. Jessup, United States.*)
20,808. ELECTRICAL BURGLAR ALARMS, J. H. Pennington and V. Yates, London.
20,809. OPENING PAPER WRAPPERS, B. Wilson, London.
20,810. NITRO-CELLULOSE, H. E. Ede and E. Ott, London.
20,811. GAME, A. Levy, London.
20,812. APPLICATION of ANTISEPTIC INGREDIENTS to LIGHTING and HEATING MATERIALS, P. Tiero, London.

20,813. Sighting Apparatus for Guns, H. Grubb and A. T. Dawson, London.
20,814. Disappearing Gun Mountings, W. L. Wise.—(*Skodawerke Actien-Gesellschaft, Austria.*)
20,815. Locks, E. L. Loewe, London.
20,816. Corset Busks, F. C. Nutter and C. A. Sewell, Limited, London.
20,817. Securing Cuffs to Shirt Sleeves, G. Rensch, London.
20,818. Producing Animated Effects, W. Gibbons, London.
20,819. Production of Beer, H. A. Hobson, London.
20,820. Signal Calls, B. Burleigh, London.

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20,821. Carriages for Machine Guns, W. E. Rowlands, Liverpool.
20,822. Pneumatic Tires, F. Westwood, Birmingham.
20,823. Automatic Couplings, S. L. Walker and F. W. Wilson, Bradford.
20,824. Weft Forks for Looms, E. Briorley, Rochdale.
20,825. Drying and Ironing Machines, D. K. Tullis, Glasgow.
20,826. Fastener for Leggings, &c, T. Cowburn, Gloucester.
20,827. Looms, A. Shorrock, Manchester.
20,828. Tripods for Photographic Cameras, B. Wilkinson, Manchester.
20,829. Loom Dobbies, E. Crook, Manchester.
20,830. Snarl Catcher for Spinning Machines, J. Eastwood, Burnley.
20,831. Driving Mechanism for Cycles, A. Roberts, Burnley.
20,832. Lithographic Printing, J. H. Newman, Croydon.
20,833. Launching Boats from Davits, C. B. Wilson, Stoke-on-Trent.
20,834. Clutch for Vehicle Axles, L. Wainwright, Manchester.
20,835. Protector for Hat-pins, A. J. Ransom, Cambridge.
20,836. Holder for Hackling Machines, A. J. Morrow, Lisburn, Co. Down.
20,837. Cycle Toe-clips, C. E. and F. B. Starckey, Chelmsford.
20,838. Suspender Buckles, W. Aufermann, Barmen, Germany.
20,839. Pocket Billiard-marker, C. W. B. Greatrex, Blackpool.
20,840. Wire Netting Machines, E. R. and F. C. Dolby, London.
20,841. Carrying Rifles on Cycles, H. Lucas and A. C. Davison, London.
20,842. Changing Object Box, E. G. Edwards, Shrewsbury.
20,843. Collars for Animals, R. H. Taunton and G. Holloway, Birmingham.
20,844. Stoppering Bottles, E. A. Matthias and W. H. Harrison, Liverpool.
20,845. Treating Metals and Alloys, J. H. S. Bradley, London.
20,846. Vehicle Wheels, G. W. Pitt and E. Martin, London.
20,847. Pipe Joint Fastener, F. Bromley and S. Smecton, London.
20,848. Free-wheel Cycles, A. Gibbs, London.
20,849. Incandescent Lights, F. W. Schroeder, J. Peters, and P. W. Moran, London.
20,850. Tooth Brushes, E. F. Streubel, London.
20,851. Screw Thread-cutting Machine, D. N. Jerauld, London.
20,852. Music Stand, A. D. and V. J. Cooper, and E. C. Rimington, London.
20,853. Driving Turbines, J. Nadrowski and C. Knorring, London.
20,854. Oil-gas Producing Apparatus, W. G. Potter, London.
20,855. Cleansing Casks, B. M. Drake and J. M. Gorham, London.
20,856. Attaching Buttons, F. Smith and G. H. Kirby, London.
20,857. Table Game, H. T. Pottenger, London.
20,858. Arc Lamps, C. V. Drysdale, New Barnet, Herts.
20,859. Centrifugal Apparatus, C. S. Berghmark, London.
20,860. Focussing Device for Cameras, H. Holmes and G. Houghton, London.
20,861. Photographic Retouching Desk, P. F. Coggin, London.
20,862. Photographic Cameras, F. H. Sanderson, Cambridge.
20,863. View Finder Adapter, G. Houghton and W. A. Edwards, London.
20,864. Sulphinic Acids, O. Imray.—(*The Basle Chemical Works, Switzerland*)
20,865. Cover Tubes, &c., for Machine Guns, O. Imray.—(*Deutsche Waffen and Munitions Fabriken, Germany.*)
20,866. Automatic Weighing Machine, E. Garvens, London.
20,867. Friction Clutches, G. Heine, London.
20,868. Electric Lamps, J. Schmidt, London.
20,869. Driving Belts, A. Wiechman, London.
20,870. Electric Signalling, H. H. Lake.—(*L. Olper, Italy.*)
20,871. Collar for Horses, G. H. Buckley, London.
20,872. Cutting Machine, H. Mullins, London.
20,873. Carbons, H. R. Gregory, London.
20,874. Decorative Treatment of Wood, E. Milo and E. J. Richardson, London.
20,875. Trawlnets, A. Rushton, London.
20,876. Boiler Furnaces, W. W. Shilling, London.
20,877. Fire Escape, J. J. Hawley, Walsall.
20,878. Telegraphic Receiving Arrangements, A. Muirhead, London.
20,879. Coin-freed Mechanism, J. T. Scott, London.
20,880. Egg Beaters, R. M. Mumma and L. E. Cowey, London.
20,881. Liquid Measuring Apparatus, L. E. Cowey, London.
20,882. Door Hinge, A. Tournon, London.
20,883. Paper Clips, C. J. Brosnan and J. T. F. Mac Donnell, London.
20,884. Hair Clippers, G. H. Coates, London.
20,885. Means for Controlling Valves, J. Langridge, London.
20,886. Hydraulic Driving Devices, A. J. Boult.—(*F. M. Hille and C. M. Gräfe, Germany.*)
20,887. Railways, J. Brown, London.
20,888. Preventing Windows from Rattling, J. M. Mills, London.
20,889. Reversible Rails, J. E. Hall, H. F. Buente, and E. R. Behlers, London.
20,890. Method for Stoppering Bottles, K. Ellis, London.
20,891. Setting Planing Machine Knives, J. E. Crake, Liverpool.
20,892. Railway Carriage Windows, A. H. C. Burrow, London.
20,893. Carbonisation of Peat, H Holm, London.
20,894. Process for Welding Metals, H. Goldschmidt, London.
20,895. Apparatus for Drying Yarns, J. Tattersall, London.
20,896. Sighting of Guns, W. Youlten, London.
20,897. Apparatus for Treating Raw Sugar, E. Casper, London.
20,898. Drums for Drying Sugar. E. Casper, London.
20,899. Transmitting Motion Intermittently, E. Casper, London.
20,900. Treatment of Raw Sugar, E. Casper, London.
20,901. Apparatus for Treating Raw Sugar, E. Casper, London.
20,902. Winches, R. L. Gamlen, London.

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20,903. Graters, E. Garland, West Kirby, Cheshire.
20,904. Automatic Valve Attachment, J. Winterflood, London.
20,905. Propulsion of Ships, R. Morris, Gateshead-on-Tyne.
20,906. Motor Cars, H. W. Clark, Brighton.
20,907. Filling Casks with Liquids, S. Mendel, Manchester.
20,908. Cleansing Oil, J. and J. R. Smith, Keighley.
20,909. Cycle Frames, W. E. Hart, sen., and W. E. Hart, jun., Wolverhampton.
20,910. Flexible Cements and Glue, R. J. C. Collins, London.
20,911. Rotary Hair Brush, A. O. Abbott, London.
20,912. Accurately Tuning Violins, T. W. Woodhouse, Doncaster.
20,913. Steam Pistons, A. MacLaine and H. Wisnom, Belfast.
20,914. Corsets, M. L. Barcley, Glasgow.
20,915. Golfing Instruments, W. Mills, Newcastle-on-Tyne.
20,916. Leggings, H. J. Cooper and J. Phillips, Birmingham.
20,917. Sliding Catches, G. Haggart and J. Arnott, Bradford.
20,918. Rocking Furnace Bars, J. Neil, Glasgow.
20,919. Garment Hooks, T. Duncan, Glasgow.
20,920. Frames of Velocipedes, J. Edwards, Folkestone.
20,921. Jointing Metal, M. J. Adams, Leeds.
20,922. Closets, M. J. Adams, Leeds.
20,923. Charger for Magazine Rifles, J. Hodgkinson, Glasgow.
20,924. Colouring Matter, E. Lefeuvre, Berlin.
20,925. Sole Striper, J. E. Hodgson, Kettering.
20,926. Electric Arc Lamps, Crompton and Co, Limited, S. L. Brunton, and A. J. Hodgson, Chelmsford.
20,927. Governors for Engines, E. Irwin, London.
20,928. Walking-stick, R. Crichton, Dudley.
20,929. Phonographs, W. Feisker, F. Schlomka, and H. Kautz, Manchester.
20,930. Automatically Extinguishing Candles, J. R. Graham and H. S. Robertson, London.
20,931. Illuminating Dining Tables, H. E. Evans, Woodford Green.
20,932. Roll-holding Cameras, P. Rudolph and O. Näther, Jena, Germany.
20,933. Photographic Shutters, E. Dönitz, Jena, Germany.
20,934. Spectacles, A. Kahn, London.
20,935. Improvements in Saddle Bars, J. T. Bednall, Birmingham.
20,936. Towing Warps, G. H. Wise, London.
20,937. Holding Reels or Balls of Cotton, G. S. Wise, London.
20,938. Diaphragms or Membranes of Phonographs, W. Feisker, F. Schlomka, and H. Kautz, Manchester.
20,939. Glazier's Soldering Iron, J. A. Stevens, London.
20,940. Applying Liquids to Paper, C. L. Burdick, London.
20,941. Appliance for Frying Eggs, B. W. Butler, London.
20,942. Systems of Motor Control, The British Thomson-Houston Company, Limited.—(*W. B. Potter, United States.*)
20,943. Systems of Motor Control, The British Thomson-Houston Company, Limited.—(*M. W. Day, United States.*)
20,944. Movable Door Checks, T. A. Silverwood, London.
20,945. Electric Telegraphs, C. Adams-Randall, London.
20,946. Electric Telephony, C. Adams-Randall, London.
20,947. Generating Acetylene Gas, K. G. Gustafsson, London.
20,948. Coated Wire Manufacture, G. E. Parker, London.
20,949. Carrying Parcels on Cycles, H. G. Turner, Coventry.
20,950. Brakes, E. J. Towndrow, London.
20,951. Running Gear for Vehicles, W. C. Skean, London.
20,952. Aerial Travelling Apparatus, E. E. Dulier, London.
20,953. Type-founding Machine, H. J. S. Gilbert-Stringer, London.
20,954. Machine for Treating Hemp, T. Burrows, London.
20,955. Mineral Oil Burners, A. Hentschke, London.
20,956. Lathes, H. H. Lake. — (*W. Scott, United States*)
20,957. Stoppering Devices for Bottles, H. T. Gay, London.
20,958. Stapling Wire, H. H. Lake.—(*T. A. Briggs, United States.*)
20,959. Engines for Driving Machines, A. Hunnable, Romford, Essex.
20,960. Reversible Galvanic Cells, T. A. Edison, London.
20,961. Cables, D. Cook, London.
20,962. Flues, H. W. Foxworthy and R. W. Moore, London.
20,963. Visor for Caps, M. Mattes, London.
20,964. Driving Mechanism for Cycles, P. Mochalle, London.
20,965. Horses' Food, L. Hamburger and H. Kallmann, London.
20,966. Garden Tool, C. J. Axten and W. T. Hall, London.
20,967. Lamps, H. H. Lake.—(*W. P. Packard, United States.*)
20,968. Device for Separating Ores, T. R. Jordan, London.
20,969. Amalgamating Apparatus, T. R. Jordan, London.
20,970. Machine for Crushing Ores, T. R. Jordan, London.
20,971. Metallic Trusses for Bedsteads, C. H. Hard, London.
20,972. Sale Books, F. M. Turck and M. E. Tracy, London.
20,973. Driving Gear for Velocipedes, P. Jensen.—(*The Hunt Manufacturing Company, United States.*)
20,974. Separating Particles, P. U. Askham and J. W. Humphrey, London.
20,975. Continuous Centrifugal Machines, W. A. Wood, London.
20,976. Removing Granular Materials, C. F. W. A. Oetling, London.
20,977. Wheelbarrows, V. A. and C. A. Gates, London.
20,978. Automatic Weighing Machine, J. W. Berry, London.
20,979. Table, C. Hirschfeld, London.
20,980. Hub Brakes, G., W., and G. H. Mackay, London.
20,981. Filling Bottles, J. W. MacKenzie.—(*W. M. Fowler, United States.*)
20,982. Meter, F. Moore, London.
20,983. Constructing Coin-freed Meters, F. Moore, London.
20,984. Waterproof Garment, &c., T. Burberry, London.
20,985. Tire Covers, The Avon India-rubber Company, Ltd., and F. T. Swanborough, London.
20,986. Pneumatic Tire Inflators, S. L. Broom, London.
20,987. Paper Toys, P. G. Reiersen.—(*S. Reiersen, Norway*)
20,988. Window Catch, W. Y. Robinson, London.
20,989. Apparatus for Poaching Eggs, M. T. White, London.
20,990. Cycle Handles, W. P. Thompson.—(*G. Wolff, Germany*)
20,991. Cylinder for Roller Printing, A. Hez, Liverpool.
20,992. Making a Molasses Fodder, R. Schrader, Liverpool.
20,993. Windows, J. C. Moore, London.
20,994. Metal Fastener for Boxes, H. M. Clements, Canterbury.

21st November, 1900.

20,995. Poles for Telegraph Lines, E. W. Serrell, London.
20,996. Automatic Water Drainer, G. W. Smith, Bradford.
20,997. Sketch Preserver, M. Edmondson and E. Hill, Leek, Staffs.
20,998. Looms, E. Hoyworth and W. Smith and Bros., Ltd., Manchester.
20,999. Screw Casement Fastener, J. E. Dean, Ashton-on-Mersey.
21,000. Ladies' Perfume Pads, W. Anderson, jun., Glasgow.
21,001. Delivering Liquids, S. G. Mason and W. Snelgrove, Birmingham.
21,002. Mounting Shafts, G. Gilbert and E. Mushing, Coventry.
21,003. Incandescent Lamp Shade Carrier, A. E. Kearsley and H. C. Bowman, Manchester.
21,004. Primary Batteries, R. F. Hall, Birmingham
21,005. Waist Bands, I. Evans, Birmingham.
21,006. Metallic Fittings for Braces, T. Walker, T. Walker, jun., A. Walker, and A. E. Walker, Birmingham.
21,007. Luggage Carriers for Cycles, C. E. Elcock, Belfast.
21,008. Flat Irons, C. W. H. Croker, Bristol.
21,009. Measuring Taps for Spirits, F. W. R. Williams, Loughborough.
21,010. Expanding and Contracting Ferrule, C. Nettleship, Alnwick.
21,011. Non-slipping Tire, B. K. Aunger, Chester-le-Street.
21,012. Safety Appliance for Cleaning Windows, H. Goldenfarb, London.
21,013. Blow-pipes for Jewellers, J. B. S. Chedburn, Glasgow.
21,014. Fraud-preventing Sale Apparatus, W. J. Wilson, Birmingham.
21,015. Gas Furnaces, W. G. Potter, London.
21,016. Portable Coal Generators, W. G. Potter, London.
21,017. Typewriters, J. D. White, Redhill, Surrey.
21,018. Combination Key-ring and Corkscrew, F. J. Coles, Plymouth.
21,019. Wrenches, C. B. Ketchum and G. W. Schwoob, London.
21,020. Parasols, A. de Micheaux, London.
21,021. Machines for Cleaning Boots, A. R. Green, London.
21,022. Excitation of Field Magnets, J. R. Blakie, London.
21,023. Pumps, C. Bonger, London.
21,024. Adjusters for Waistbands, A. A. Abbott, London.
21,025. Electric Switches, The British Thomson-Houston Company, Ltd.—(*F. W. Hild, United States.*)
21,026. Electric Railway System, The British Thomson-Houston Company, Ltd —(*W. B. Potter, United States.*)
21,027. Electric Circuit Ground Detector, The British Thomson-Houston Company, Ltd.—(*W. H. Pratt, United States.*)
21,028. Electric Railways, The British Thomson-Houston Company, Ltd.—(*P. Farnsworth, United States.*)
21,029. Tachometers, The British Thomson-Houston Company, Ltd.—(*C. D. Haskins, United States.*)
21,030. Electric Railways, The British Thomson-Houston Compady, Ltd.—(*W. B. Potter, United States.*)
21,031. Controlling Electric Motors, The British Thomson-Houston Company, Ltd.—(*A. H. Armstrong, United States*)
21,032. A Black Polish for Iron, &c., C. Bordes, London.
21,033. Metal Printing, D. Owen, London.
21,034. Photograph-printing Apparatus, F. W. Suter, London.
21,035. Apparatus for Infusing Tea, F. Moser.—(*H. Moser, Austria.*)
21,036. Switches for Electric Lamps, H. M. Salmony, London.
21,037. Bicycles, H. Laming and E. Brown, London.
21,038. Cycle Brake, C. A. Day.—(*New Departure Bell Company, United States.*)
21,039. Levels, J. J. Hicks and F. W. Holmes, London.
21,040. Hot and Cold Water Tap, H. J. Quilter, London.
21,041. Relieving Milling Cutters, M. M. Griffiths and A. E. Langley, London.
21,042. Arc Lamp Carbons, T. A. Rose and A. Barnes, London.
21,043. Hackling Flax, J. Horner and J. A. Laughlin, London.
21,044. Cellulose Fibreless Threads, W. A. E. Crombie, London.
21,045. Retainers for Neckwear, W. O. Horn, London.
21,046. Measuring Device, R. Riedel, London.
21,047. Boxes and Box Staples, A. M. Young, London.
21,048. Device for Manipulating Valves, J. Dring, London.
21,049. Apparatus for Cutting Grass, J. E. Ransome, London.
21,050. Toilet Requisites, J. H. Newman, Croydon, Surrey.
21,051. Actuating Brakes on Bicycles, T. M. Adair, Belfast.
21,052. Manufacture of Metal Tubes, S. Frank, London.
21,053. Apparatus for Punching Metals, S. Frank, London.
21,054. Internal Combustion Engines, S. F. Wiles, London.
21,055. Compressed-air Brakes, J. Lipkowski, London.
21,056. Hair-drying Apparatus, H. Sonnen, London.
21,057. Ignition Devices, A. J. Westlake and A. Bluhm, London.
21,058. Manufacture of Camphor, W. M. Binnie and C. Smith, London.
21,059. Slabs for Asphalt Pavements, J. Wetter.—(*H. Beck, Germany.*)
21,060. Machinery for Labelling Cans, E. Rankin, London.
21,061. Quick-drying Liquid Cement Paint, W. Ward, London.
21,062. Agglutinating Material, T. Ingham, Liverpool.
21,063. Coloured Marking Inks, A. Raynes, London.
21,064. Combined Letter Sheet and Envelope, J. J. Denison, London.
21,065. Detonators, L. Wöhler, London.
21,066. Automatically-regulated Injectors, I. N. V. Bablon, London.
21,067. Devices for Steering Gear, A. Bollee, London.
21,068. Manufacture of Explosive Substances, J. Bonnet, London.
21,069. Cutting Profile Iron, R. A. G. Hurtung, London.
21,070. Feed-water Heaters, A. W. Hamilton and A. A. McMaster, London.
21,071. Bells, E. D. Rockwell, Birmingham.
21,072. Yarn Making, F. V. M. Raabe, London.
21,073. Treating Textile Fibres, F. V. M. Raabe, London.
21,074. Incandescence Gas Lamps, W. Knopf, London.
21,075. Removing Incrustation in Boilers, T. Lowther, London.
21,076. Material to Resemble Cloth, S. H. Sharp, London.
21,077. Stopping a Power Loom, J. J. Zubler, London.

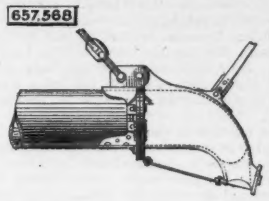
SELECTED AMERICAN PATENTS

From the United States Patent-office Official Gazette.

657,568. Mouthpiece or Drag for Suction Pipes for Dredges, *A. W. Robinson, Milwaukee, Wis.*—*Filed December 8th*, 1899.

Claim.—(1) In a suction pipe, a drag or mouthpiece hinged at one side to the pipe, and held thereto at the other side by easily-ruptured devices, for the purposes set forth. (2) In a suction pipe, a drag or mouthpiece connected to the pipe by easily ruptured devices, and means whereby the drag or mouthpiece can be re-

657,568

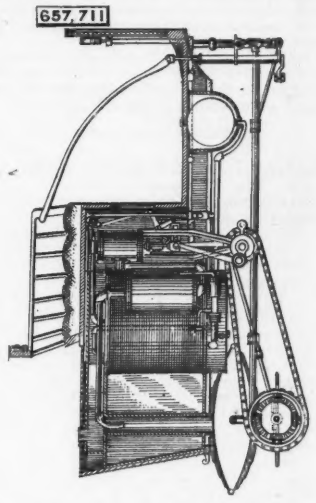


covered after said devices have been ruptured, for the purposes set forth. (3) The combination of a suction pipe, a drag or mouthpiece, a hinge connection between the two at the upper side of the pipe, and means upon the side opposite the hinge whereby the mouthpiece will be held in operative position unless subjected to excessive strains, for the purposes set forth.

657,711. Motor Vehicle, *F. E. and G. O. Stanley, Newton, Mass.*—*Filed October 16th*, 1899.

Claim.—(1) In a motor vehicle, the vehicle body, a steam boiler therein, a hood extending over the boiler and to the rear end of the vehicle body, a flue extending from said hood upward and at the rear of the vehicle, and a flue extending downward below the body of the vehicle, whereby the discharge may be conveyed to the rear, either above or below the vehicle body, substantially as set forth. (2) The combination with the body of a vehicle, of a boiler, engine, burner, and water tank having a flue extending downwardly through it to receive the gases passing from the boiler, and an exhaust pipe arranged to direct the exhaust steam into said downwardly extending flue, substantially as set forth. (3) The combination with the body, burner, and boiler of a motor vehicle, of a hood extended beyond the seat to the rear of the body, and discharge flues opening upward and downward from said hood at the rear of the seat, substantially as set forth.

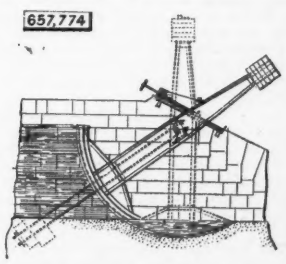
657,711



657,774. Water Gate, *H. A. Icke, Pietermaritzburg, Natal.*—*Filed July 13th*, 1899.

Claim.—A water gate having a damming surface consisting of the segment of a circle, means for balancing the said gate about a horizontal axis coincident with the centre of the said curved gate, in

657,774

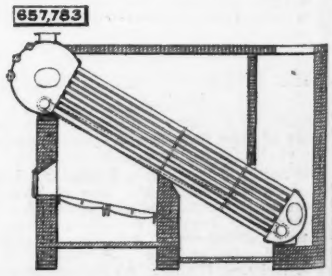


combination with a controlling counterbalance weight K, a well containing said balance weight, always in communication with the water under control, and means to connect said balance weight with the water gate, substantially as described.

657,783. Steam Boiler, *C. D. Mosher, New York, N.Y.*—*Filed April 25th*, 1894.

Claim.—In combination an upper chamber, a pair of lower chambers, groups of tubes connecting the upper

657,783



with the lower chambers, plug holes in the upper chamber through which the tubes are adapted to pass, and plugs for closing the holes

FOREIGN AND ENGLISH PRACTICE IN ELECTRICAL AND TECHNICAL INDUSTRY.

No. IV.

THE consulting engineer seems to be almost entirely an English institution. He is misnamed to begin with. No doubt he was originally supposed to be an analogue of the consulting physician. When your own doctor, who does not know what to do with you next, thinks it policy to admit it, he advises a consultation with a specialist, or consulting doctor. The consulting physician is called in, and treats you as a specimen, and is supposed to give the benefit of his superior experience and special knowledge to your own doctor. If the consulting engineer were in an analogous position he would be called in by less experienced engineers to advise them. For instance, if a maker of engines wanted to improve his designs he would bring the drawings up to Westminster, and discuss them with a venerable gentleman who had made engines all his life, and could tell the less experienced man at once how to improve his type. But this is not at all the work of consulting engineers. They are really merely in the position of architects. No engineer in general practice would dream of consulting a consulting engineer if he were in a difficulty. On the contrary, it is much more frequently his lot to help the consulting engineer out of a hole.

In the law, the barrister to some extent corresponds with the consulting doctor. A solicitor, a man of law himself, goes to a barrister as a specialist in some branch of the law to get definite advice. The solicitor very often knows more than the counsel, but he is not supposed to know more, and he gets the responsibility off his shoulders. Though interesting, it would be perhaps a little out of place here to consider the broad question of consulting engineers in general. The discussion ought to be confined to the electrical consulting engineer. There are many considerations, however, which affect the question, or concern consulting engineers in general, whether electrical or not.

As already mentioned, the theory of a consulting engineer is that he is an eminent and experienced man who advises other engineers of less eminence. This theory does not fit the facts, however. Another theory is that he is called in by non-technical people to design works, and have them carried out by contractors. In this case the theory fits the facts pretty closely, and the consulting engineer is in a position analogous to that of the architect. Now, the first question that arises is, Is the consulting engineer better able to design the work than the contractor? The consulting engineer thinks he is, of course, and the contractor has no say in the matter; so the consulting engineer has his way. He may leave the broad principles to the contractor, and only bother himself about details and fads of his own, merely altering the contractor's suggestions until the scheme has something to individualise it, and make it the consulting engineer's own.

The consulting engineer might be merely a buyer, whose business it is to see that his client gets good value for his money, and is not defrauded; but this is a view seldom taken by him.

The sinister effect of the system of consulting engineers on the engineering progress of this country is incalculable. This is because the manufacturing engineer, instead of making what he considers or knows to be best, or rather what he knows he can make best, is obliged to turn out work to suit the notions of a consulting engineer who has probably very much less knowledge or experience in the particular kind of work. It must be remembered that the idea is that the consulting engineer is the specialist, and the manufacturing engineer is the all-round man, with superficial knowledge and rule-of-thumb experience. It is really quite the other way round. The consulting engineer is asked to deal with all sorts of problems, ranging over the whole domain of engineering. His knowledge must therefore be very general; and his knowledge of any particular branch may be sound, if he is an able man, but it must at the same time be meagre. Now, the manufacturing engineer probably only makes one thing, and devotes his whole energy to understanding it, and making it as well as he can. It is generally the manufacturing engineer who is the specialist. He is hampered, however; and his great difficulty is that he cannot standardise his manufactures. If he had to deal with only one consulting engineer he might standardise all his fads; but he has no such luck; he must alter his patterns, and re-design his engines for each tender. Not only is this system directly costly, but it has demoralised us. America—where the consulting engineer in the English sense is unknown—has taught all the world but England how to make machinery wholesale. A few English firms are taking up manufacture on the interchangeable system; but as a whole it is entirely against the grain of the English engineer. This is very largely because our absurd system of consulting engineers has rubbed the idea firmly in that each order must be different from all the others, and no two engines, bridges, steamers, or sets of plant should be alike. The consulting engineer not only injures our home trade and developments, but his evil influence is just as strong in the case of foreign, and especially colonial work, as it is in most cases under the control of Great George and Victoria streets.

But we are more especially interested in the effect of consulting engineers on electrical development as compared with foreign countries.

In the early days of electric lighting it could hardly be said that there were any consulting electrical engineers in the ordinary sense. There was no need for them until town lighting came in. Then companies took to calling all sorts of queer people in, apparently because they thought they were eminent rather than because they knew anything about lighting towns. Then the consulting engineer got mixed with the contractor sometimes, and he has not quite extricated himself even yet. A few towns were entrusted to the tender mercies of technical college science masters. This seems an extraordinary notion. Imagine entrusting, say, the water supply of Birmingham to a schoolmaster. Yet this is what was often done in electric lighting, and the results were not nearly as bad as might have been expected. It must be because the electrical professors were a very superior sample. The evils of the consulting engineer system have shown themselves more strongly in electrical engineering than almost anywhere else. While America was manufacturing Westinghouse, Thomson-Houston, or Edison plants complete for towns, with the units interchangeable, we in this country were making dynamos and engines, and everything else, bit by bit, and one by one. We could do nothing else.

The design of a machine for one order had to be altered because Professor Prigsome, who was consulting engineer, had calculated that the best output per pound of copper, disregarding the cost of iron and anything else that would have interfered with his calculations, is when the armature length is 3·14 times its diameter; and in the next the commutator has to be re-designed because Dr. Diditbefore thinks he has invented a new brush holder, and there was no room for it otherwise.

But all this is of the past. The whole position of the consulting electrical engineer has changed since the municipalities took to doing their own lighting. At present the state of affairs is very curious. It is against the etiquette of the profession for a consulting engineer to apply for clients, or to tout for work, or to advertise, or push himself directly in any way. Whether this etiquette is a good thing or not is not to the point for the moment. Town councillors are not the sort of people who would know anything about such matters as professional etiquette. The result has been that when there has been a consulting engineer wanted, all sorts of people except the best men have applied for the appointment. The sequel is that the consulting practice, as far as town lighting and traction goes, is almost entirely in the hands of people who have not been ashamed to apply for it. There are two or three consulting electrical engineers in the first rank who would never dream of doing anything of this sort, who have kept their practice by their ability and reputation; but the majority of the work of the country especially in connection with the small towns, is in the hands of people frequently of no position, knowledge, or experience, who have got hold of it by unprofessional means. It is an open secret that many electrical consulting engineers apply to local authorities for employment, and, in some cases, even engage travellers to sound their praises for them. Now, their conduct is not criminal; they have only broken the etiquette of their profession. The result is that with the exception of the one or two already mentioned, engineers, who are high in their calling and do not like to break through the etiquette of their profession, get practically no town work, and make their livings in other ways. So much the worse for them. As to the towns—well they do not get the best men, and that is their lookout. But it must be bad for the industry if the men of best standing in the profession are debarred by etiquette from doing much of the most important work in the country.

The local authorities are going still further now; they are taking to advertise for consulting engineers.

It is difficult to see any way out of the difficulty. The Institution of Civil Engineers is largely controlled by consulting engineers; and if such a state of things came about among civil engineers in general, they would deal with it very forcibly; but the civils would hardly deal with electrical engineers, of whom only a few are even members. The Institution of Electrical Engineers, on the other hand, is weak, and is not representative of consulting engineers and hardly of electrical engineers generally. It has done nothing in this matter. It will, therefore, probably go on.

Of course no blame attaches to the consulting engineers individually who apply for work, for if A, who is not known, sees B, who is senior to him and better known, applying, he feels he must do the same or become hungry. He therefore does the same. There are many legitimate ways of advertising. Putting an advertisement in a paper is, of course, forbidden, though we have seen it done by an electrical consulting engineer. The most elementary forms of admissible advertisement are to wear a large fur collar, or a Homburg hat in town, or to wear the hair long, or eschew ablution, or run a double name. All these methods are means of getting people to say, Who's that? Most of them are played out and old. The double name is the most recent; but it is already so largely adopted by the self-advertising second-rate, both in society and elsewhere, that it is nearly played out too. Then there is writing to the *Times*. This is a good method, for certain technical papers attach more importance to letters written to the *Times* than to their own columns, and copy them. Writing papers with newspaper-catching titles for the British Association is a good medium. They come out in the silly season, and a paper on "Electrical Ballooning," "Electrical Colour Photography," or "Rapid Electric Railways without Rails," will generally go the round of the country, especially if there is no autumn session of Parliament.

These are only elementary methods after all. Indirect advertisement is a high art, and though we might tell our readers all about it, it would be irrelevant.

The best thing for the electrical industry in this country would be for the consulting engineer to disappear altogether, his place being taken by a buyer, who merely see that his clients get good value for their money, without dictating to the contractors how the work ought to be done.

IN a report to the Water Committee of the Tenby Town Council, Mr. James Mansergh recommends that a supply be obtained from Precelly Mountain at a cost of £67,000. To carry out this scheme Mr. Mansergh suggests a joint scheme between Tenby and other towns in Pembrokeshire, and recommends the Town Council to approach the various local authorities with the view of ascertaining whether they would fall in with the project.

LOCOMOTIVE EXHIBITS AT VINCENNES.

By CHARLES ROUS-MARTEN.

No. III.

RESUMING my review of the locomotive exhibits at Vincennes, I may observe that since my previous article was written I have had further opportunities of testing the remarkable capabilities of the engine type which I deem the most successful for express work that the Paris Exhibition has evoked, viz., the latest four-cylinder compound on the Chemin de Fer du Nord. Illustrations of the two engines already built to this latest design of M. du Bousquet on the de Glehn compound principle were appended to my former article—THE ENGINEER, September 21st, pp. 288-290—and to-day the detailed drawings are given. These will enable a very exact idea to be formed of the methods which have been adopted to secure the results aimed at.

Being courteously invited by Monsieur du Bousquet to assist at some fresh trials of the new engine, I arrived at Calais to find No. 2.641 waiting there to take the corridor dining-car train to Paris. It was somewhat unfortunate for the purposes of the trial that the express was able to get away with absolute punctuality instead of leaving twenty-four minutes late, as on the occasion of my previous trip, for as the booked time from Calais to Paris was ten minutes longer than in the opposite direction, in order to allow for making up the time lost between London and Dover, or in the Channel crossing, or in the transfer of luggage, the margin was too large to enable the engine to do its best work throughout. Thus the trials had to be made in short "spurts" on the more significant lengths of the road. Nevertheless this superfluously large allowance of time, 3 h. 40 min. for the 185¼ miles, is 35 minutes longer than the best time from Manchester to Euston, the English distance being slightly shorter and the English road far easier. The load hauled on this occasion by the French locomotive was 267 English tons, exclusive of the weight of engine and tender.

With this load, No. 2.641, after starting very smartly from Calais Gare Maritime, ascended the eight miles continuous bank of 1 in 125 to Caffiers at a minimum speed of 52·2 miles an hour, which was steadily maintained along the last five miles to the summit. The corresponding descent to Boulogne was made without steam and with an occasional touch of the brake, to avoid passing the place too much in advance of booked time, which had been prohibited by the authorities. Similarly the engine merely played with the train along the level length to Abbeville, and thence—after the usual stop for water, extended in this case to seven minutes—onward to Amiens, passing through that curved and turntable-infested station at a slow walking pace. From Amiens, it will be remembered, there is a steady ascent at 1 in 250 and 1 in 333 for 26 miles, viz., to Gannes, this bank closely resembling that from Willesden to Tring, but being longer and somewhat steeper. Leaving Amiens Station at a speed of only three miles an hour, the velocity rapidly increased to 40, 50, and 60 miles an hour as we mounted the bank, and then to 62, 64, and finally 65·5 miles an hour, which we maintained to the summit, although our load behind the tender was 267 tons. Thenceforward it was necessary to keep down the speed to avoid unduly early arrival in Paris, thus the descent to Creil occupied 27½ minutes, whereas the corresponding ascent for the same distance had been made in 24½ minutes. But the work done by the engine may be gathered from these facts:—(1) That if the whole journey from Calais to Paris, up-hill and down-hill and level, had been made at an average pace the same as the lowest at which the eight miles bank of 1 in 125 was ascended, the entire run would have been done in five minutes less than the booked time. (2) That had the whole Calais-Paris journey been done at the same average speed as the lowest maintained up the last twenty-three miles of the bank of 1 in 250 and 1 in 333 to Gannes, the entire journey would have been accomplished in 2 h. 50 min. This will give some idea of the uphill work, with a load of 267 tons, and it emphasises what I have more than once pointed out that, the superiority of French locomotive work is wholly in the ascent of rising gradients, and not in downhill spurts.

But a still more remarkable exhibition was to follow. This consisted in the engine, No. 2.641, being required to haul a train, the Nord express, weighing 365½ French tonnes, or 360 English tons, from Paris to St. Quentin, 95¾ miles, in the booked time of 102 minutes, without the aid of a pilot engine, the journey including the ascent of one bank at 1 in 200 for 13 miles continuously, and another at 1 in 333 for 10 miles, and the average start-to-stop speed being 56·4 miles an hour. In view of the enormous load to be hauled at so high an average speed, it was not deemed wise to start five minutes late, as on the previous occasion, when the load was 305 tons, but the sequel showed that this might have been done with advantage to the result of the experiment, for Tergnier was reached so much in advance of booked time that, as in the former case, the driver had to "ease down" during the remainder of the journey. Not the slightest trouble was experienced in starting out of Paris with that huge load of 360 tons behind the tender, and when the sixth kilometre post was passed the speed had already reached 62·1 miles an hour. The ascent of the thirteen-mile bank of 1 in 200 was begun at this rate, which diminished very gradually to 52·2, the absolute minimum, but then rose again, still steadily climbing the 1 in 200 gradient, until a rate of 57 miles an hour was attained, which subsequently decreased slowly to 53·4, and then began to increase again just before the summit was reached. The average speed up the whole thirteen-mile length of 1 in 200 was 56·1 miles an hour, and the lowest, as already stated, 52·2. When it is remembered that the load was 360 tons behind the tender, and that this ascent is at the same rate as from Bedford to Leagrave, on the Midland line; Wood Green to Potter's Bar, Arlesey to Stevenage, and Grantham to Stoke, on the Great Northern; Reston to Grant's House, on the North

British—the last worked by North-Eastern locomotives—and steeper than those approaching Litchfield Tunnel from either side, on the London and North-Western, the remarkable character of this performance will be realised.

In the descent to Creil care was taken not to exceed the authorised "special" maximum rate of 77·5 miles an hour, although a separate experiment with a *train d'essai* showed that the engine could easily run at a speed of 85·8 miles an hour down 1 in 200 with a load of over 250 tons and yet be well within her powers, while the running was as easy and steady as could be desired. In this case, however, the authorised special limit of 125 kilometres was never exceeded.

Creil (31¾ miles) was passed at reduced speed in 33 min. 10 sec. from the Paris start, and then came 50 miles on end of almost dead level, but with a slight inclination to rise, very similar, in fact, to the Paddington-Didcot stretch on the Great Western. This stage of 50 miles, from passing Creil at half-speed to passing Tergnier, was covered in 47 min. 34 sec., but more than a minute had been lost through a signal check a little south of Compiègne. The latter was passed in 53 min. 40 sec. from Paris, or 52½ min. net, the distance being 52¾ miles. While the train was *en plein marche*, as the French officials expressed it—at full speed—the rate along the level and slight rise varied only between 65 and 70 miles an hour. Tergnier, 81¾ miles from Paris, the same distance as Amiens, was passed in 80 min. 44 sec. from the start, without allowing anything for the signal check. If the delay thus caused be deducted, it leaves the Paris-Tergnier time 79½ min. net for a run of 81¾ miles, with a load of 360 tons behind the tender, drawn by one engine. It may be recollected that on the previous occasion, with 305 tons, the same run was made in 75 min. 18 sec. Two such performances as these are quite without parallel in my experience, and are even unapproached. This early passing of Tergnier left nearly 21 min. for the remaining 15 miles, so unfortunately it became necessary to "ease down," to avoid arriving unduly in advance of booked time. A second signal check at Montescourt caused nearly another minute's delay, and a third adverse signal brought us to a standstill in St. Quentin yard, just outside the station, the 95½ miles from Paris having been run in 96 min. 13 sec. gross, from start to stop, or in 94½ min. net, if the signal delays be deducted. The final stop inside St. Quentin Station was made in 97 min. 31 sec. from Paris, or 4 min. 29 sec. under the fast booked time, in spite of signal delays amounting to 3 min. 35 sec., and of speed being eased down all the way from Tergnier. This is an achievement that will take a good deal of beating, seeing that the load would be reckoned as thirty-six coaches on the South of England lines, or thirty on the Midland.

The next duty assigned to this remarkable engine consisted in taking the corridor dining-car boat train from Paris to Calais Pier. The load was 235 tons, exclusive of engine and tender, which would have been reckoned as "23½ coaches" had it been running between Dover and London. Although the time allowed for the 185½ miles—two miles farther than from Euston to Manchester, and virtually the same distance as from King's Cross to Leeds—is only 3 h. 30 min., with a six-minute stop at Abbeville for water, pending the laying of the troughs, the engine found a difficulty in filling up the time, and was stopped dead in Creil Station 32 min. 9 sec. from the start, being ahead of booked time, so that the road was not ready. Subsequently we were badly checked several times through the mail train having broken down in front of us. This latter, however, was shunted at Abbeville, but we were delayed 14 minutes outside and in that station. Leaving Abbeville six minutes late, we ran steadily at 70 miles an hour along the level length to Etaples, and at 57·5 miles an hour up the rising gradient of 1 in 135, which extends for about four miles thence. Adverse signals were encountered at Pont de Brique, and a bad slack for relaying near Boulogne; but then a vigorous rush was made at the eight miles ascent of 1 in 125, and with the effect that the speed up the last five miles to the summit averaged 61·8 miles an hour, and never fell below 55·2. A smart run down the corresponding descent brought us—after yet one more signal check at Fontinette—to a standstill at Calais Pier, opposite the Gare Maritime, a minute before booked time. Now, the total delays by two extra stops, five signal checks, and a relaying slack, amounted to 23½ minutes, without taking any account of the slowing to walking pace through Amiens, and the six-minutes regular stop for water at Abbeville, with its separate slackening and starting. But if those be added, the total delays amount to 10 minutes more. This will enable an idea to be formed how easy it will be to make the journey in three hours when the water-stop shall be rendered unnecessary through the adoption of the track-trough and tender scoop, notwithstanding that the distance is as far as from London to Leeds, and farther than from London to Manchester. I make these comparisons in order that English readers may be able the better to realise what work those French engines are actually doing.

Yet one more trial has been made during the Exhibition season with the free one of the Exhibition twins Nos. 2.641 and 2.642. The former was tried with a relatively light load of 154 English tons, equal, however, to fifteen South of England coaches, as officially computed at 10 tons per coach. The programme was to attain the authorised ordinary maximum rate, 120 kiloms., or 74·4 miles an hour, as soon as possible after starting from Paris, to attack the 13-mile bank of 1 in 200 at that rate, and to maintain it undiminished to the summit. Events rendered it impracticable to carry out this programme, but what was done afforded strong ground for believing that, but for unforeseen contingencies, it would certainly have been accomplished. These contingencies consisted in no fewer than four signal stops between the third and seventh kilometre posts. As a consequence we started on the bank itself from a state of absolute rest. But our speed rose so steadily and persistently, that when we passed the summit after 12 miles of continuous mounting up 1 in 200, the speed had risen to 73 miles an hour, and was still rising. Let any reader imagine this being done approaching Potter's Bar or Corby or Grant's House from the south, or Harlington from the north, and the true meaning of the performance by No. 2.641 will be realised. Barathon, in each case, as before, was the skilful driver of the engine, and from Monsieur Rudloff, who was once again in charge of the experiments, I experienced the same courtesy and assistance that I have so often had the pleasure to acknowledge. I append a log of the Paris-St. Quentin run.

I may add that as I write I am in receipt of a communication from an official source to the effect that still more recently the same engine, with a load of 230 tons, has made the run from Paris to Amiens, 81¾ miles, in 71 minutes, and from Amiens to Calais Pier, 103¾ miles, in 96 minutes, in each case from start to stop, or 2 h. 47 min. total running time. This may be left to speak for itself, but the fact should be borne in mind that Leeds is practically the same distance from King's Cross, and Manchester two miles nearer to Euston, *viâ* Stoke. Interesting possibilities are thus suggested.

I have dwelt at some length on this notable phase of the Northern Company's part in the Locomotive exhibits at Vincennes, partly because it is, so far as I am aware, unique—there being no other instance within my knowledge of a railway company building two Exhibition engines, one to be on view *in situ*, and the other to be simultaneously running show trains on the railway which is to be the future theatre of the operations of both; and, secondly, because the performances of the outside "twin" have also been unique in my experience for their extraordinary excellence. In this case I include in my comparison all the voluminous statistics that have reached me as to the performances of other engines. For after careful collation I can find nothing that equals at all points these achievements of No. 2.641, Chemin de Fer du Nord. I do not say that they have never been equalled. I only say that I have no knowledge of such having happened. But I do not doubt that this and more will be accomplished in the future, and, I earnestly hope, in Britain.

It does not appear to be necessary to enlarge at much length upon most of the other de Glehn compounds at Vincennes, because "sister" engines of those shown respectively by the Orleans and Est railways have recently been described and illustrated in The Engineer (August 17th, 1900, and July 6th, 1900, respectively), and specimens of their work—in the case of the former—given in some detail. Moreover, they are the latest-born of the family, and have sprung into existence full-grown, as it were, without having experienced the gradual up-growth from small beginnings that characterised the establishment of the de Glehn four-cylinder compound type on the Nord, Midi, and P.L.M. lines. It is true that the Orleans and Est compounds possess each some special characteristics according to the particular design of M. Solacroup and M. Salomon respectively, but these have been sufficiently dealt with in the descriptions already given. In the case of the other French railways, however, on all of which the same compound type has been adopted as the standard, there are various special points worthy of notice, with which I hope to deal in my next article.

The following is the log of the trial run with engine No. 2.641, Chemin de Fer du Nord; load, 360 English tons, exclusive of engine and tender, and 468 tons inclusive of engine and tender:—

Miles ex Paris.		Stations, &c.	Actual times.		Due.
—	...	Paris ... ...dep.	1 50 36	...	1 50 0
3¾	...	St. Denis... ... ...pass	57 4	...	—
6¼	...	Pierrefitte ... ... ,,	59 31	...	—
9¼	...	Villiers-le-Bel ... ,,	2 2 48	...	—
12¼	...	Goussainville... ... ,,	6 45	...	—
14¾	...	Louvres ... ... ,,	9 0	...	—
18¼	...	Survilliers ... ... ,,	13 9	...	—
21¾	...	Orry... ... ... ,,	16 8	...	—
25¼	...	Chantilly... ... ... ,,	19 3	...	—
31¾	...	Creil (slack) ... ... ,,	23 46	...	—
34¾	...	Rieux ... ... ,,	27 34	...	—
38¾	...	Pont St. Maxence... ,,	31 28	...	—
44½	...	Longueil S.M. ... ,, (Slack by signal).	37 7	...	—
52¾	...	Compiègne ... ... ,,	44 16	...	—
56½	...	Longueil A. ... ... ,,	48 10	...	—
57½	...	Thourotte ... ... ,,	49 10	...	—
60½	...	Ribecourt ... ... ,,	52 7	...	—
63	...	Ourscamp ... ... ,,	54 22	...	—
66¾	...	Noyon ... ... ,,	57 57	...	—
71¾	...	Appilly ... ... ,,	3 2 37	...	—
77	...	Chauny ... ... ,,	7 7	...	—
81¾	...	Tergnier... ... ... ,,	11 20	...	—
88¼	...	Montescourt ... ... ,, (Slack by signal).	18 10	...	—
91	...	Essigny ... ... ,,	21 50	...	—
95½	...	St. Quentin Yard... arr. (Stop by signal).	26 49	...	—
		dep.	27 10	...	—
95¾	...	St. Quentin Station arr.	3 28 7	...	3 32 0

BOOKS RECEIVED.

Fowler's Mechanical Engineers' Year-book for 1901. Edited by Wm. H. Fowler. Manchester: Scientific Publishing Company. Price 1s. 6d. net, and 2s. 6d.

An Elementary Text-book of Coal Mining. By Robert Peel. Seventh edition. London: Blackie and Son, Limited. 1900.

A Contents-Subject Index to General and Periodical Literature. By A. Cotgreave, F.R. Hist. S. London: Elliot Stock, and West Ham Public Libraries. 1900.

A Century of Copper. Part II. Expansion of the Industry; Cost of Extraction; Uses of the Metal; Distribution of Ores, &c. By Nicol Brown and Chas. Corbett Turnbull. London: Effingham Wilson. 1900. Price 5s.

Report of the Board of Education, 1899-1900. Vol. i., The Report, price 6d. Vol. ii., Appendix to Report (Secondary Education), price 1s. 3d. Vol. iii., Appendix to Report (Elementary Education), price 3s. 6d. London: Eyre and Spottiswoode. 1900.

It is announced that a coal company at Pittsburg has contracted to ship 450,000 tons of bituminous coal to Nantes by way of Baltimore.

LITERATURE.

Structural Iron and Steel: A Text-book for Architects, Engineers, Builders, and Science Students. With numerous examples, illustrations, diagrams, and tables. By W. T. Twelvetrees, Member of the Institution of Mechanical Engineers; Vice-president of the Civil and Mechanical Engineers' Society. London: D. Fourdrinier, *Builder* Office, Catherine-street, W.C., and Whittaker and Co., Paternoster-square, E.C. 1900.

In the commencing chapter relating to "Iron production," the varieties and chemical constitution of the three principal iron ores, the extraction of the metal from them, the operations of roasting, smelting, and finally the turning out of the resultant pig iron, are successively treated. When comparing the relative values of the cold and hot-blast processes, it is stated that the economic advantages of the hot-blast process are now thoroughly appreciated by English and Scotch manufacturers, but in a minor degree by Welsh smelters. This inferior estimation is said to be due to the fact that the iron ores produced in Wales are not of a highly refractory character, but so readily reducible, that the possible saving by the aid of the newer method is comparatively small. It may, therefore, be inferred that a natural superiority of the ore might be attended with results due to that cause, and not to any particular method of smelting. The pig iron produced by either process will be found to be a simple mixture, or, perhaps, an alloy, varying in composition, but from which cast, malleable, and wrought iron and steel are subsequently made.

The author goes at some length into the manufacture of iron, apparently assuming that his readers know nothing about it. He tells them that as it is rarely that castings are made from one kind of iron, several brands are mixed together, and their relative proportions will depend upon the form to be given to the casting, to the work required of it, and to the stresses to which it may be subjected. The knowledge necessary to ensure the proper proportions, and to attain the desired results, belongs to the art of the founder, whose practice includes, in addition to metal mixing and castings, pattern making, moulding and furnace work. From the mixture of different brands of iron, or, as it may be correctly termed, by a system of judicious blending, eight grades of cast iron have been developed for commercial utilisation, each of which has a distinct and easily recognised mark attached to it. Blends are also made by mixing two or more of the eight grades, and it has been found that combinations of numbers 1, 3, and 4 are well adapted for constructive purposes, producing clean and strong castings. After a brief description of the older processes for making wrought iron, including dry puddling, which is now rarely used, the author passes on to the more modern method which the furnaceman designates as pig-boiling. The conversion of the puddle ball into the bloom, then into the puddle bar, the formation of the pile, and from it the production of mercantile forms of iron in the shape of bars, plates, angles, tees, and rails, all of any required section, are very clearly described, and the description may prove useful to those who require little save a superficial knowledge of the subject.

The Bessemer, the Siemens, and the Bloomery processes, the last being still used in America and elsewhere, though only suitable for naturally pure and rich ores, need no further mention on our part. In alluding to the manufacture of steel, the author remarks that "the term is applied to metals differing so widely one from another in strength and other qualities, that some confusion exists as to what may really be meant by 'steel.' It is impossible, in fact, to determine where wrought iron ends or where steel begins." Without discussing this question, which is far more of a theoretical than of a practical nature, we have, at any rate, a constructive material under the name of "mild steel," which the Board of Trade, an authority which is by no means prodigal in its regulations and concessions, permits English engineers to stress up to six and a-half tons per square inch, which is some advance beyond the four and five tons allowed in the case of wrought iron. The same department permitted a unit stress of seven and a-half tons to be employed in certain members of the Forth Bridge, but that was a special dispensation, warranted under the peculiar attendant circumstances, and very possibly not likely to be repeated.

When discussing "external forces, stresses, and strains," it is enunciated that "loads may be described as internal when the force exerted arises from the weights of the parts themselves, and as external when they are due to the influences of other bodies." This distinction appears to us to be more specious than real. Theoretically when working out either analytically or graphically the determination of the stresses upon the various members of a bridge or roof girder or truss, their weight is frequently for the time neglected. But when it becomes subsequently necessary to assign to each member its adequate sectional area, the weight of the girder and truss must be added to the load already assumed, and becomes a part of the dead permanent load, and cannot be regarded in any other light than that of an external load or force. The distinction is, moreover, a little confusing, especially if it is to be assumed that "although the force of gravity itself is actually an external one, its direct manifestation may be inside a body." It is satisfactory to observe that Mr. Twelvetrees adheres strictly to, and defines very clearly, the modern signification of the terms stress and strain.

We quite concur in the statement that "impact tests have not received the amount of attention which their importance deserves." As the question at present stands, the effect of a moving load in comparison with one of a static character will never be even approximately determined until more experiments have been carried out upon railway bridges under actual working conditions and the resulting stresses accurately ascertained. We shall then

be in possession of information hitherto hidden from us, and the knowledge thus acquired will, if we are not mistaken, cause great changes in the old stereotyped ideas prevailing respecting the general subject of dead and live loads. The author is not far wrong when he observes that "a factor of safety is not only meaningless, but is based on entirely fallacious premises." As a matter of fact, the so-called factor of safety is little better than a term to express our own ignorance respecting the real nature and effect of dynamic action.

In Part II., the method of making joints, the puncturing and drilling of plates, and riveted, bolt, and other descriptions of fastenings, are fully treated of, and although there is nothing particularly new in this portion of the contents of the volume, it will well repay perusal. Rules are given for apportioning the diameter and pitch of rivets in both single and double shear, and for the thickness of plates, and for the dimensions of other details in connection with joints and fastenings. That full practical knowledge of the building up of the different parts of iron and steel structures, which can alone impart confidence and competency, can only be acquired after considerable training and practice in a first-class drawing-office. There the designing of bridges, roofs, and other examples of constructive iron and steelwork upon a large scale is a matter of daily occurrence, and the pupil and apprentice acquire there insensibly all that essential practical information which no book can teach them.

Columns of cast iron, wrought iron, and steel are treated of in the first three chapters of Part III. Therein the author, while admitting that it is to Hodgkinson's experiments, carried out some sixty years ago, that we are still indebted for the chief sources of our knowledge as to the strength of columns, rejects his somewhat antiquated, inconvenient, and troublesome formula now but little used by engineers. He wisely prefers that of Professor Gordon and the modification of it by Rankine, while at the same time frankly accepting the inevitable, "that results given by the two formulæ are apt to exhibit considerable differences." In "Bending Moments and Shearing Forces," a word of warning is addressed to those who are in the habit of consulting inadvisedly text-books and pocket-books with respect to the formulæ for calculating the safe loads of joists, girders and, trusses of different types of construction. In able and experienced hands these compilations save time and labour, but in others they are frequently a delusion and a snare. A brief reference is made to "Graphical Diagrams," and the application of this simple and elegant method to the ordinary cases of loads on beams and cantilevers sufficiently investigated as far as the scope of the work permits. In alluding to open web girders—for they could not be discussed in the present treatise—it is observed "that beams with latticed webs are used in building construction where great strength is necessary." This assertion is not borne out in practice. If we take, for instance, large examples of building construction, such as extensive warehouses, and heavy goods stores of our great railways, similar to those of the Great Eastern at Liverpool-street,* it is never the lattice girder that is employed, but what the author terms the "compound beam," known to engineers as the box girder. It may be mentioned that "joggling" can very frequently be avoided by the insertion of filling or packing pieces. It must, however, be resorted to in cases where the filling strips become very long, as it would not be justifiable to introduce the large amount of extra riveting required. A joggled joint, nevertheless, never affords the same neat, finished appearance of one of the flush pattern. A chapter on floor-framing and an appendix, containing a selection of useful practical tables, completes the present volume, which is, in many respects, superior to others of the "Students' Series" of our contemporary. It is written in a free, open style, and, above all, brought well up to date, a most meritorious feature, which by no means invariably attends books which are partially reprints, and assumed to be efficiently revised and amended.

A Text-book of Gas, Oil, and Air Engines. By BRYAN DONKIN. Third edition, revised and largely re-written. London: Chas. Griffin and Co., Limited, 1900.

THERE is probably no book on gas and oil engines more widely read and more generally respected than that of which the third edition lies before us to-day. It is, indeed, so well known that the reviewer's commendation is scarcely necessary. But when a work has appeared before him so often the critic is tempted to turn aside from the pleasant and easy task of praising its many excellencies to look for omissions and defects.

As a history, past and contemporary, of internal combustion motors it would be difficult to imagine a book more complete than Mr. Donkin's; but when we turn from the descriptions of engines and their parts, and look for information on their use and operation, we find ourselves at a loss. A chapter on gas and oil engine driving would not have occupied much space, and would not, we think, be out of place in a text-book, because several points bearing on the proper construction of the engine could be more clearly demonstrated by considering the difficulties or benefits which result from their use than by any other method. A scientific writer is apt to forget that in the use of an engine economy and efficiency are not always the most important features. It is frequently of far greater moment that an engine should work with the minimum of intelligent attention than that it should consume a minimum of fuel. To put a concrete case, it is far from incredible that a simple agricultural engine, consuming, say, 1¼ lb. of oil per brake horse-power per hour, might be more economical than a superior engine requiring only 1 lb. of oil for the same output, if the attendance of a farm hand was sufficient for the former, whilst more expensive labour was required for the other. We think, then, that Mr. Donkin would have added to the value of his work if he had included some critical remarks on the actual use of heat engines. For example, it is well known that certain conditions will cause the deposit of carbon in the cylinders. We have an impression that Mr. Donkin has referred incidentally to this fact, but the index gives no clue to the passage, and there is certainly no attempt to discuss the matter fully. Again, every one is aware that under certain conditions of working and construction the charge in a cylinder will strike back or ignite at the wrong time and in the wrong place. It is of the greatest importance to both the user and designer of gas engines that they should know the exact causes which conduce to this result, but as far as we can find Mr. Donkin does not discuss them. Another point—small, perhaps, in that it can be readily answered, but still of importance—is the nature of the oil to be used as a lubricant in the cylinder and the quantity of it required. We are speaking from the designer's point of view when we say that these points all require more attention than they are given in this volume, or shall we say, more systematic attention for such like details as the proper proportion of diameter to stroke, the correct point of ignition, the area of ports and passages, &c.; we know they are in the volume, but it is only with difficulty that they are found. We are aware that in a series of chapters, forming a very excellent summary, the views of different workers on many essential problems are very ably discussed, and we have but little doubt that nearly all the omissions we have mentioned are only omissions in appearance, as answers will be generally found by an intelligent study of the volume; but that is not enough. Mr. Donkin's book is used for reference, and it should therefore be made possible to find rapidly all the information possible on any desired topic.

On more specific points, too, we might ask for further information. Take the important question of governing. We have a general discussion of the subject, excellent in its way, and we have a brief description of the governing arrangements in connection with very many of the engines mentioned; but there are not enough drawings or sketches of governors, nor is any attempt made at showing the practical working out of the various methods enumerated. Self-starting devices, and the various methods of mounting ignition tubes, particularly porcelain tubes, are also but scantily treated.

But after all is said and done, it has to be admitted that there are few more able books than Mr. Donkin's, and if there are omissions, the reader may at any rate be satisfied that he cannot be led astray by any statements he finds in the volume, and may rest assured that the views of every authority are ably and accurately expressed, and that where the author gives his own opinion it has only been reached by profound consideration and lucid judgment.

Penrose's Pictorial Annual: The Process Year Book, 1900. Penrose and Co., 8 and 8A, Upper Baker-street. Price 3s. 6d.

IT is scarcely possible to speak too highly of the taste and care shown in the get up of this charming annual, which surely demonstrates triumphantly the yearly advance of process work, particularly in the direction of half-tone and colour reproduction. Even in this last most difficult branch process seems likely to achieve results which, but a few years ago, would have been regarded as outside the bounds of possibility—at any rate in England, where we are still far behind our continental and American neighbours in the matter of colour work. What will be of more immediate interest, however, to the readers of THE ENGINEER, is the question of process *v.* wood engraving. To the editor of the *Process Annual*, who naturally holds a brief for the former, the answer is not in doubt—to him the days of wood engraving are numbered, and even for such subjects as machinery and furniture he claims that process has abundantly vindicated its superiority, "*Not* because it is cheaper . . . it is not, where best work is concerned—but because it is better." Nevertheless, with all deference to the opinion of Mr. Gamble, we confess to preferring the woodcuts to the process blocks given in the Machinery Supplement to THE ENGINEER for November 23rd. It must be remembered that there is a difficulty in doing justice to process blocks owing to the great rapidity required in journalistic printing, though probably in time this may be surmounted. Certain admirable and picked samples of machines in the volume before us go far to justify his contention, however. Nothing could well give a would-be purchaser a better idea of Taylor and Challen's machine, for instance, than the half-tone block by Wantage and Gillett, worked up for catalogue printing. That process work has been so slow of adoption for the illustration of catalogues, where a fac-simile reproduction of the article for sale is all desirable, is indeed astonishing, and can only be accounted for by the inherent conservatism of the British mind—always slow to overcome the *vis inertia* of habit.

Before closing this brief notice, we would draw attention to the article on "Photo Plastic," dealing with a novel application of photography hitherto unsuspected by the general public, though it appears to have been a dream of theorists as far back as the year 1861. To begin as a photograph and end as a *bas relief* seems to the lay mind as impossible a transition as the traditional "silk purse from a sow's ear." The difference seems one of kind, not one of degree. Yet it has been bridged over by the singularly ingenious process, a lucid description of which will be found on page 25, by Hofrath O. Volkmer, director of the Imperial Printing and State Paper Offices in Vienna. Not having seen examples of it, we are unable to say how far the result is, artistically speaking, successful. The volume before us forms the sixth of a very interesting series. It will be technically valuable, we imagine, as recording the latest advance and improvements in photo-lithography, and forms in addition a very artistic book, with pictures that are likely to be highly appreciated by many who are profoundly ignorant of the methods by which they are produced.

MINERS' WAGES IN SOUTH WALES.

THE views expressed last week in an article on "The Coal Position in South Wales" were confirmed by the result of the Sliding Scale audit, which awards the colliers from December 1st an increase of 2½ per cent. in wages, making the rate 73¾ above the standard of 1879, and raising it, in fact, to a height never known before in the history of the trade. The argument was, it may be remembered, that though there has been a gradual decline in coal prices from the maximum quotation of 30s. per ton, yet there has been no such abrupt transition as to justify its description as a collapse or "slump." Among its other merits, the Sliding Scale affords the best, if not the only, means of discovering what the movement in prices has actually been over any length of time. There have been fluctuations with a downward tendency since the beginning of the year; but nevertheless wages based on the average net selling prices f.o.b., have advanced by successive stages of 5 per cent., 13¾ per cent., two rises of 5 per cent., then 12½ per cent., and now 2½ per cent.—an aggregate increase of 43¾ per cent. since January, or a total increase of 61¼ per cent. since the close of the strike, with one intervening reduction of 1¼ per cent. in February, 1899. The Sliding Scale, moreover, serves another useful purpose besides that of a test of the changing position of the trade. It supplies a clue to actual prices as compared with those published week by week or day by day on 'Change. The audit declared on November 30th covered the months of September and October. Take, for example, the official market reports as supplied to THE ENGINEER for September 28th and October 26th, which dates are selected as sufficiently representative. On the former day, at Cardiff, best steam is cited as again at 29s. to 30s., and the lowest price, No 2 Rhondda "through," 15s. 6d. to 16s. 6d.; while the October quotations are:—Best steam, 24s. to 26s.; No. 2 Rhondda "through," 15s. to 15s. 6d. But on reference to the Sliding Scale table it is seen that when wages are 73¾ per cent. above the 1879 datum, the average price of coal must have been between 16s. 3·43d. and 16s. 5·14d., the exact average apparently being a fraction over 16s. 4d. The difference between this sum and the average which would be struck between highest and lowest of the official quotations is considerable, and is not to be accounted for by the relatively lower figures of the Swansea market. The coalowners who have been standing out for high prices attribute the discrepancy to the practices of the middlemen, who compete for contracts and custom at less than ruling rates, trusting to a turn in the market to give them a profit; while the middlemen retort on their accusers that there are members of the Coalowners' Association who covertly make bargains at under-cutting rates, thus reducing the average and spoiling the market at the same time.

With wages 73¾ per cent. above the standard, and materially higher than they were in 1873—when coal rose from 23s. to 32s. per ton, falling in December to 22s. 6d.—it might have been thought that the colliers were contented, and the more so because they are assured on respectable authority that, although the Scale may have reached summit level, a reduction is not likely to be in sight for six months to come. They are not satisfied, however; the chimerical idea of maintaining prices by restricting production still haunts them, or, at least, it pervades the minds of their leaders; and at the Joint Sliding Scale meeting on November 30th, the coalowners were invited to appoint a special day to discuss "a mutual scheme for the control of output of coal." The request covered more than appeared on the surface, as was presently revealed. But on the proposal of limiting the supply, the coalowners' representatives were outspoken, and even peremptory. The subject had received a decent meed of consideration when Mr. D. A. Thomas, M.P., urged his fantastic scheme, "made in Germany," for Limitation of the Vend; and it was more respectfully debated in all its possible bearings, when Sir W. T. Lewis submitted a plan whereby the collieries should, in effect, enter into something like a pooling arrangement for regulating the output when prices had fallen to a certain level, the pit or pits closed down to be recompensed out of a common fund. But then, as now, the Association declined to be beguiled into a departure from orthodox economics; and last Friday the workmen's delegates were informed that the masters were unanimous in refusing to entertain the proposal of a joint conference, or to discuss a restriction of the output in any form whatever. Mr. Archibald Hood, who presided, went further, and, protesting against the unauthorised "stop-day" of a few weeks ago, announced that in the event of any similar illegalities on the part of the colliers the Coalowners' Association would put the law into force. This led to the disclosure of the *arrière pensée*, which is Mr. Pickard's everlasting topic—namely, a minimum wage. "Mabon," M.P., intimated that, whether the owners agreed or not, the men would take their own measures for limiting production in a very effectual manner, as occasion arose, and when the underselling tactics of middlemen reduced prices below a certain fixed point; for the men were determined that their wages should be protected, and a minumum appointed on a permanent level. What, however, the amount of the minimum wage was to be, the workmen's representatives were unable to say, when they were requested to give the coalowners some facts to consider. It is evident that while wages have been on the ascending scale for nearly two years, "Mabon" and his colleagues have not troubled to discuss the basis of a minimum, or, as they prefer to call it, a "living wage." Nor, while wages remain 73¾ per cent. above the 1879 standard, is it probable that they will perplex themselves with a question belonging to a day of small things, the recurrence of which both masters and men are agreed in desiring to postpone as long as they can?

GAS ENGINES AT THE PARIS EXHIBITION.—The firm spoken of as Messrs. Dudbridge in our issue of November 16th, is the Dudbridge Ironworks, Limited, formerly Humpidge, Holborow, and Co. The dimensions of their four horse-power engine should have been given as 6¾ diameter by 9½in. stroke. We are requested by Richard Hornsby and Sons, Limited, to state that the vaporiser in their oil engine is only used in starting.

PROTECTION OF INDUSTRIAL PROPERTY.—The President of the Board of Trade has appointed the following to be British delegates to the Conference of the Union for the Protection of Industrial Property, to be held at Brussels on the 11th inst.:—The Right Hon. C. B. Stuart Wortley, M.P., Hallam division of Sheffield; Sir Henry Bergne, K.C.M.G., Chief of the Commercial Department of the Foreign-office; Mr. Cornelius N. Dalton, C.B., Comptroller-General of the Patent-office. Mr. Balfour has also appointed Mr. Herbert Hughes, of Sheffield, to be technical adviser to the British delegates, and Mr. Edward Vicars, of the Foreign-office, to be their secretary. Mr. Hughes is the secretary and treasurer of the Sheffield Chamber of Commerce. It is quite probable that the report of Sir Edward Fry's Committee may be published in time for consideration by the Committee.

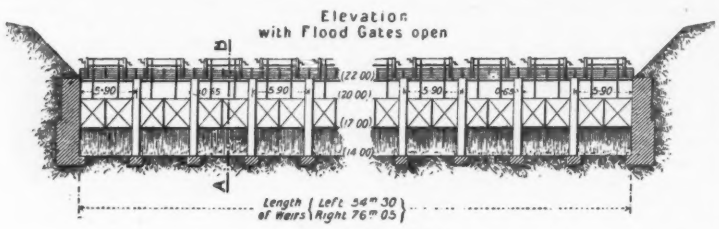
* THE ENGINEER, June 8th, 15th, 29th, 1894.

CENTRAL AMERICAN SHIP CANALS.

No IV.

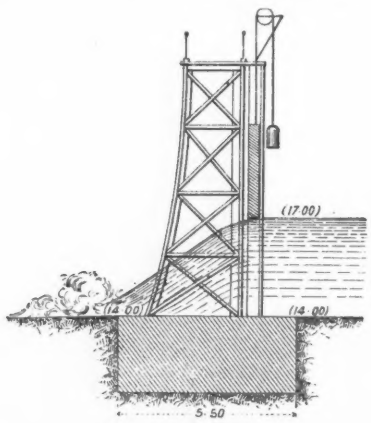
As has been already remarked, one very important feature of the scheme proposed for the control of the torrential Chagres is the free passage towards the Atlantic, during periods of maximum flood, of 1200 cubic metres per second. This is to be accomplished by the provision, at some distance from the Bohio dam, of two regulating weirs connected with river diversions on each side of the canal. One of these, with a bye-wash of 54 m., will be constructed at Bohio, on the left of the canal, and serve to dispose of 500 cubic metres per second; while the other, with an outlet of 76 m., will be established in the neck of the Rio Gigante, on the right of the canal. The following drawings serve to indicate the dimensions and general character of these weirs, which are to be of the Stoney design, so successful in operation on the Manchester Ship Canal. A few words, however, may be necessary to make clear the operation of the flood-gates. These will be 3 m. high, and, when completely lowered, will rest on sills fixed at the point 14 m. above sea-level.

In periods of drought, when the level of the lake may fall to a point 16 m. above sea, the gates will be completely lowered, but in normal times they will either remain closed or be raised to the point necessary to maintain the lake surface at the mark 17—this additional reserve of 1 m. being a provision for losses by evaporation and infiltration. When a flood occurs, the hatches will be successively raised—for the purpose of preserving this level—to afford outlet for whatever surplus presents itself, until—the maximum height of 3 m. having been reached—the discharge equals 1200 cubic metres per second. From this time, if the supply of flood-water is in excess of that volume, the hatches will be lowered so as to limit passage through the weirs to the current in question, and the surplus will naturally be thrown back and impounded in the lake, raising its level above the point 17. It could thus happen, if the flood were very severe, that the level of the lake reached the point 20; all the gates would by that time have been completely closed, their crests would be brought back to the point 17, the flood-water exceeding the height of 3 m. would roll away in a maximum stream of 1200 cubic metres per second, and the storage in the lake of 150,000,000 cubic metres would be realised. To secure these ends, it has, of course, been necessary to calculate very precisely the length given to the weirs. Analogous arrangements are contemplated at the Alhajuela weir, but in this case the maximum discharge per second will be 700 cubic metres, and the quantity impounded 100,000,000 cubic metres.



THE BOHIO WEIRS

To carry off the flood-water discharged through the Bohio weirs, the river diversions partially executed on both sides of the canal by the de Lesseps Company will be completed and utilised. Embankments, however, will be raised wherever they appear necessary to protect the canal from any possible overflow, and in the event of any accidental addition to the discharge of 1200 cubic metres per second coming from the weirs, the excess will drain into the bed lying between the channel and the canal levees. It should also be noted, as regards the Rio Gigante weir, that the flood waters flowing thence will lose much of their initial force in the neighbouring morass of Pena Blanca.



THE BOHIO WEIRS

The principal requirements estimated for in connection with the works contemplated at Bohio, dam and weirs, are:—

Excavation	1,057,800 cubic metres.
Clay puddling	325,700 ,,
Cement masonry	34,050 ,,
Dry-stone packing	18,900 ,,
Rockwork	39,900 ,,
Wood for piles, &c.	3260 ,,
Ironwork	213,500 kilos.
Sluices	425 square metres.

The other dams and weirs accessory to the locks present no difficulties worthy of note, whether regarded from a technical standpoint or in relation to cost. Generally speaking, it has been possible to secure sites which provide a rock foundation, and in such cases concrete dams are contemplated. The most important are those intended to close the valley of the Rio Obispo and throw the waters of that river into the channel of the "Divide;" and the Pedro-Miguel dam, which is to be of earth, and is destined to close the valley of the Rio Grande on the right of the canal. Opposite to it, on the left side, in a rock cutting of the railroad, which will here be deflected, a masonry weir is contemplated. The following table summarises the more important details concerning these works:—

	Dam.		Weir.		Excavation required.	Earthwork.	Rockwork.	Masonry.	Ironwork.	Flood-gates.
	Length at crest.	Extreme height.	Length.	Max. discharge.						
	m.	m.	m.	c.m.	c.m.	c.m.	c.m.	c.m.	kilos.	sq. m.
Obispo	100	18·25	50	70	4,460	—	—	8,000	20,000	50
Paraiso	99	8	35	50	442,700	—	—	5,200	7,000	33
Pedro-Miguel	389	9·75	47	—	47,950	111,900	7,500	690	—	—
Miraflores	96·50	5	—	—	869	—	—	1,000	—	—

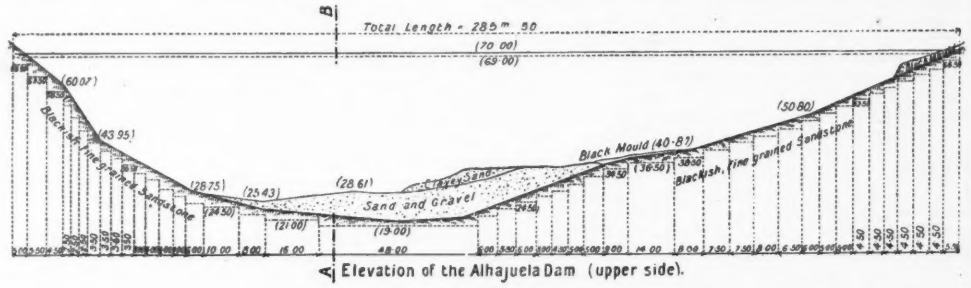
As noted in an earlier article, the dam projected at Alhajuela will have a triple purpose: (*a*) to hold back a portion of the waters of the Upper Chagres, and so assist in controlling the floods, (*b*) by the creation of a vast reservoir in which the latter will be impounded, to supply the summit level during the dry season—usually about three months—and (*c*) to furnish the necessary hydraulic power, transmitted by electricity, for operating the canal. The site proposed for it is a constricted rocky gorge, situated about ten miles north-east of kilometre post 45, where the Chagres for the first time touches the route of the canal. It will be founded on compact rock, the greatest depth of which is about 9 m. below the Chagres low-water mark, or 28·40 m. above the mean level of the oceans. The lake which it is destined to create will have, at the point 61 m. above sea, a superficies of 2300 hectares, or 5182 acres. The surface of the water in the feeder at the latter's junction with the lake has been fixed at the point 58, and there will be a gradient of 16·75 m. in the 15½ kiloms. of conduit in which the water will flow on its way to the "Divide." The water which should be stored in the reservoir for the alimentation of the canal and the production of motive power, as well as to compensate for the natural losses of the lake itself, has been estimated at 160,000,000 cubic metres, equal to a depth of about 23½ft., from points 58 to 64·50 m. above the sea. Between the latter point and the estimated maximum level of the reservoir—68 m. above sea—it is proposed to impound 100,000,000 cubic metres of flood; consequently, as the low-water mark is at point 28·40 m., the estimated maximum reserve in the lake will be 40 m. in depth. As will be seen from the plans which accompany this article, it is proposed that the dam shall be 285·50 m. long, measured along the crest — which is to be strengthened with a parapet about 3½ft. high—with an elevation of 51 m. from foundation to summit at the deepest part of the valley. It will be constructed of concrete masonry, and the cross section appears to be in complete accordance with the requirements of modern engineering in that the maximum pressure per square centimetre does not exceed 6·50 kilos. As an accessory to the dam, a regulating weir is projected on the left bank of the Chagres on the rocky ridge against which the dam will be supported. It is estimated that five years will be required to complete the dam, and that the latter will call for—

Excavation	ordinary earth	51,400 cubic metres
	rock	18,900 ,, ,,
Masonry work		150,000 ,, ,,

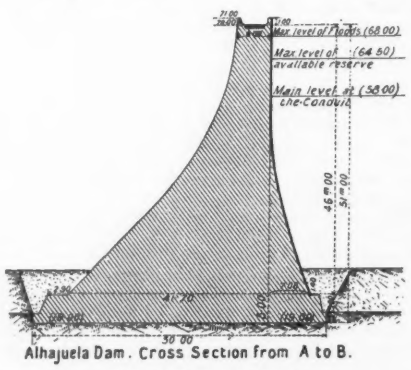
The regulating weir will be of similar design to those contemplated at Bohio, and will be capable of discharging 700 cubic metres per second. This weir will necessitate the excavation of no less than 103,200 cubic metres of rock, much of which, however, will be of service in the construction of the dam.

During the operations at Alhajuela, it will be essential to divert the waters of the Chagres, and for this purpose a temporary dam, 300 m. long, will be required.

The feeder needed to connect the Alhajuela reservoir with the summit level of the canal will have to pass through ten miles of rough and, in many places, difficult country. The project of the Technical Committee provides for a uniform flow of 25 cubic metres per second, but is sufficiently elastic, in the improbable event of that volume being proved insufficient, to readily secure an increase. The gradient will be equal to 0·80 m. per kilom. in parts where the sides are of unfaced earth or rock, and 0·60 m. in the tunnels, trough bridges, and the open conduit between the two ducts spanning the valley of the Chilibre. The first section of the route, a distance of 3½ kiloms., must traverse the flank of a plateau on the left side of the Chagres, cut up by ravines, at the feet of which flow meandering streams. For the purpose of clearing these gaps, dams founded on rock, and forming so many lakelets for the passage of the conduit, will have to be constructed, while in other places the ridges of the plateau, for an aggregate distance of 595 m., will require to be tunnelled. The second section of the route, rather longer than 3 kiloms., includes the valleys of the Chilibre and Juan Mina, tributaries of the Chagres, and these will have to be spanned by aqueducts, one 1400 m. long, the other 610 m. long, united by an open channel 1140 m. in length. These ducts will consist of three metal tubes, each of 2·40 m. diameter, posed on cast iron gratings on a concrete bed, and the foundations contemplated would admit of the ultimate receipt of a fourth tube in the event of it being deemed desirable to increase the capacity of the feeder. The third section follows a hilly flank on the slope of the left bank of the Chagres, often intersected by narrow ravines, which will be cleared, sometimes by trough bridges, sometimes by means of dams, as in the first section. Several ridges will require to be tunnelled, and from the point where the conduit abuts on a high hill, separating the Rio Gamboa from another valley, a tunnel 430 m. long is projected. Altogether, there will be on the route of the conduit 28 dams and dykes, representing in the aggregate 29,000 cubic metres of masonry; 15 earth dykes, representing a cube of 11,400 m.; a levee of puddled clay and earth, 230 m. long, and representing a cube of 69,000 m.; 14 short tunnels, of the aggregate length of 1555 m., and the longer tunnel already mentioned. It will be seen from this necessarily condensed description that the construction of the feed-water conduit will be relatively costly, but there appears no reason to doubt the accuracy of those responsible for the surveys and plans that the projected works present no very serious engineering difficulties or elements of insecurity. For the execution of the entire scheme there will be required, it has been estimated:—



THE ALHAJUELA DAM



THE ALHAJUELA DAM

Excavation { Ordinary soils	232,000 cubic metres.
{ Rock	386,000 ,,
Earth dykes and levee { Earth	73,000 ,,
{ Puddled clay ...	8,400 ,,
Tunnelling	1,555 metres.
Dams and dykes in concrete masonry	29,000 cubic metres.
Ducts over the valley of the Chilibre, including the three tubes, platform, and shed	2,010 metres.
Iron foundation for same	45 ,,
Trough bridges over the Falupa and Falupita	90 ,,
Light tramways to the various works	5,000 ,,

The railway, 16 kiloms. 200 m. in length, which is con-

templated to open up the region of the Upper Chagres, will have its origin near Gamboa, where it will join the existing track along the route of the great cutting and connected with the Panama Railroad. It will extend to a plateau overlooking the site of the Alhajuela dam, on which will be placed the workshops and other installations incidental to the enterprise, and will *en route* touch all the more important points along the *rigole d'alimentation* where operations requiring the supply and accumulation of material are projected. The specifications for its construction include :—

Excavation	Ordinary	125,500	cubic metres
	Rock	35,900	" "
Embankments		170,300	" "
Masonry for constructive works		8,630	" "
Metal bridging		179	metres

Reference to the map published in THE ENGINEER of October 26th, will show that a considerable section of the Colon-Panama Railroad cannot be maintained in its present route without seriously interfering with the project for the completion of the canal; it would not only cross the latter, but also be permanently inundated in the area created by the Bohio dam. It will consequently be necessary to effect a rectification of the line so as to bring it always on the left side of the navigable channel, and outside the region covered by the waters of the Bohio lake. It is proposed that the deflection shall commence a little distance from the site of the dam, at the kilometre post 23·000, and rejoin the existing line at Miraflores. The proposed deflection would, therefore be about 50 kiloms. long.

It has been deemed expedient to limit present attention to the first needs of the enterprise, and to reserve for future consideration the question of increased harbour accommodation at the two extremities of the canal. There already exists at Colon a fair harbour, provided with basins and wharfs in direct communication with the Panama Railroad; and it appears not unlikely that these works, though admittedly restricted, may, with the provision of an inner harbour, within the canal itself, meet the requirements of the first vessels making a transit of the new highway. This projected basin would be a prolongation of Folk River bay, and be 1000 m. long and 150 m. broad. A pile pier would be constructed along one side, and ample room for anchorage would be found on the other. At La Boca, near the Pacific, the Panama Railroad Company has already provided considerable facilities for shipping, and these could be much increased in the future.

Such, in brief, is the present condition of the studies for the Panama Canal, and there now only remains for consideration—before passing to an inquiry respecting the rival schemes—the estimated cost of the works, which it is fondly hoped will result in the completion of this hitherto ill-starred and often misunderstood enterprise. Intimately associated with the estimates is the question of labour supply. This, from the point of view of climatic influence, has already been touched upon. Experience has demonstrated that the evil character of the climate may in a measure be redeemed, and that, with reasonable care and precautions on the part of the administration, there is at least one race which may be depended upon to withstand the comparative insalubrity of the isthmus. As to their recruitment, the Special Technical Commission offers the following observations :—

> Will it be possible to recruit the number of labourers judged needful for the accomplishment of the project? There are at this moment about 3000 on the works. The number should be increased to 5000 in the first year, reach 16,000 during the period of greatest activity, and average 12,000 during the ten years assigned for the completion of the enterprise. The American Commission appointed in 1895 to examine the Nicaragua project estimated that 15,000 to 20,000 Jamaican labourers could be engaged under contract. It is, therefore, not rash to conclude that 12,000 such labourers could be assembled at Panama. The old company imported into the isthmus a much larger number. The particulars which have been furnished us confirm the possibility of enlisting them, subject, however, to the condition that no obstacle will be raised by the Government of their country, and that, on the other hand, the Nicaragua Canal is not proceeded with at the same time as that of Panama.

The estimates of cost of the various works appear to have been framed with considerable circumspection. It is possible that, in some particulars, practical experience on a large scale may result in modifications more or less important; for instance, the units adopted as the bases of calculation may be reducible by improved methods of working, while, on the other hand, the course of exchange may exercise a certain influence on the price of labour in the isthmus, where payments are made in silver. It is not, however, believed that such considerations will sensibly affect the aggregate estimate, or the assurance that the latter may properly be regarded as a maximum. The average prices applied, including transport and workmanship of all kinds, are: For drag-work, 3f. and sometimes 3·50f. per cubic metre; for ordinary excavations, 3·50f.; and for excavation of rock, 5·50f. per cubic metre. These have been fixed to accord with the net cost of the work actually in progress in the central cutting, with certain modifications which appear to be justified by future conditions. The unit adopted in the case of masonry for the locks and dams on the route of the canal is 50f. per cubic metre, increased to 60f. for the Alhajuela dam. The following are the estimates arrived at by the Technical Committee, grouped under convenient heads :—

	Francs.
(*a*) Excavation of the canal—	
Atlantic section	20,568,000
Bohio Lake section	33,225,000
The Divide	118,675,000
Paraiso section	6,363,000
Pedro-Miguel section	4,781,000
Pacific section	30,387,000
On account of omissions and contingencies	21,000,000
Linings of the canal	7,000,000
	242,000,000
( ) Locks—	
Bohio group	32,216,000
Obispo group	29,928,000
Paraiso	15,945,000
Pedro-Miguel group	28,851,000
Miraflores	15,799,000
Approach basins, hydraulic machinery, &c.	1,675,000
Contingencies	12,586,000
	137,000,000
(*c*) Dams and weirs—	
Bohio dams and weirs, including the temporary works	10,981,000
Obispo weir-dam	451,700
Paraiso dam and weir	1,348,700
Pedro-Miguel	896,900
Miraflores	50,200
Alhajuela, including accessory works	12,210,700
Contingencies	4,060,800
	30,000,000
(*d*) Flood channels and widening—	
Channel on left of canal	5,547,000
Channel on right of canal	5,550,000
Widening at various points of the Bohio Lake	3,298,700
Contingencies	1,604,300
	16,000,000
(*e*) Railroads—	
Deflection of the P.R.R.	14,000,000
Upper Chagres railroad	1,617,000
Contingencies	383,000
	16,000,000
(*f*) Feed-water conduit—	
Estimated expenditure	15,000,200
Contingencies	1,999,800
	17,000,000
(*g*) Miscellaneous—	
Purchase of land, &c.	6,000,000
Arrangement of motive power, &c.	13,000,000
	19,000,000

The Technical Committee has thought fit to add to the 477,000,000f., the aggregate of the estimated expenditure enumerated above, a further lump sum of 35,000,000f. "on account of works which have not been considered, and the necessity of which may hereafter be revealed." This brings up to nearly 57,000,000f. the reserve for "contingencies," certainly a very considerable margin, and increases to 512,000,000f. the expenditure deemed adequate to ensure the completion, equipment, and opening of the canal. This estimate might be reduced by about 40,000,000f. by postponing the construction of the second chamber to all the locks, or increased to 525,000,000f. (£21,000,000) by at once providing the locks with two chambers of equal width—questions which, it may be remembered, were referred to in our last article.

HOLDERS AT THE BIRMINGHAM GAS-WORKS.

No. I.

THE steady extension in the use of gas throughout the country, which goes on unchecked notwithstanding the concomitant increase in the application of electric lighting, is nowhere better illustrated than in the city of Birmingham, where both the gas and electricity supplies are now in the hands of the Corporation. Despite the immense progress made by the electric light undertaking in Birmingham, the gas consumption grows apace. For instance, during the twelve months ending 31st March last the quantity of gas consumed was 7·6 per cent. greater than in the preceding twelve months. The causes of the continuous growth in gas consumption are not obscure. The use of gas for heating and cooking increases every year, while gas engines are brought into more and more general application. But, perhaps, of late years, the prepayment meter, on the penny-in-the-slot principle, has been the most potent factor in extending the consumption of gas. Thanks to this admirable invention, gas is rapidly becoming the general illuminant in the houses of the working-classes, where until recently it was practically unknown. Birmingham, in common with other large centres of population, has experienced the impetus which the prepayment meter has given to gas consumption, and the works and storage accommodation existing a few years ago proved so inadequate to meet the growing demands for gas, that very extensive additions were planned, many of which have now been completed. These additions are noteworthy both in respect of their great extent and of excellence of design and execution. As the sequel will indicate, they embody engineering works of the first magnitude.

The gas department of the city of Birmingham was formed in 1875 to take over the management of existing works which had been purchased by the Corporation from private companies. The engineering staffs of the companies were retained virtually in their former positions when the transfer to the Corporation was carried out. The engineer of the late Birmingham and Staffordshire Gas Company, Mr. Henry Hack, M. Inst. C.E., was retained as engineer to the Swan Village and Saltley Works of the gas department of the city, and the new Nechells Works, adjoining Saltley, have now also come under his control. The remaining two works of the department are under the management of Mr. Charles Hunt, M. Inst. C.E. The Birmingham Gas Department was fortunate in finding two such capable engineers in charge of the works which were transferred to the Corporation in 1875, and no little portion of the success which has since been achieved by it has been directly due to the great ability of each of these men. It is at Saltley and Nechells that the most recent extensions and additions have been made, and it has therefore fallen to Mr. Hack's lot to design and supervise the construction of gas plant on a scale which is only equalled at Beckton and perhaps East Greenwich, and the new municipal gasworks at Vienna. We are indebted to Mr. Hack for the placing at our disposal particulars of the new plant, together with the drawings and views which we shall reproduce for the purpose of this article, of the gigantic gasholder which has lately been completed at Saltley.

Before proceeding to describe this new gasholder—photographs of which during construction will be found on page 563—we may fitly refer to an enlargement of an existing gasholder which was carried out before the erection of the new one. This gasholder was originally completed in 1876, and had a capacity of about 2,000,000 cubic feet. No better illustration could be afforded of the great changes which have been made in gasholder construction than the scheme for the enlargement of this gasholder. The guide framing of a modern gasholder is essentially different from that of one made in 1876, while that again differs from the earliest examples. The bell, or holder proper, has likewise undergone substantial changes since gasholders were first made. The No. 5 gasholder at Saltley, of which we are now speaking, was built during the transition period in gasholder design. The guide framing of the earliest holders consisted merely of three or more independent posts or columns of cast iron, and a simple bell, of which the height was limited by the depth of the tank. Very soon horizontal girders connecting the columns were introduced. In the case of small holders, having only three guide columns, the tops of the columns were connected by girders, which formed a triangle above the crown of the holder. But where a greater number of columns were employed, the connecting girders were throughout their length outside the circumference of the bell, and it was therefore possible to introduce them at any point between the bases of the columns and their tops, instead of only at the tops. These horizontal girders, assisted in some cases by diagonal ties, did not materially alter the character of the guide framing, which still depended chiefly on the independent strength of each of the heavy rigid columns. But by degrees the girders increased in importance, until in the modern gasholder the columns are so braced together by them and by diagonal ties that the guide framing becomes in effect a stiff vertical hollow cylinder. The columns independently would be totally inadequate to resist the strains which the guide framing is called upon to stand, but the system of bracing them together by tiers of struts or girders, and diagonal ties, converts them into a framing which cannot be distorted appreciably from its cylindrical form except by fracture, or an uprooting of the holding-down bolts. The changes in the type of guide framing have been accompanied and rendered possible by the change from cast iron to wrought iron and steel as the material used in its construction, just as steel lattice girders have taken the place of cast iron girders in other branches of engineering work. Nowhere is the significance of this change more marked than in gasholder construction, as a cursory comparison of modern guide framing with that of thirty years ago will show.

The bell of the gasholder also has undergone great changes since the early years of gasholder construction. Starting as a simple cylindrical shell as high as the tank is deep, and provided with a roof or crown, it has gradually developed into a telescopic structure of as many as six lifts, each of which is as high as the tank is deep. Broadly speaking, a tank such as that of the largest gasholder at the East Greenwich works would, under the old system of a simple non-telescopic bell, have been adapted for a gasholder of a maximum capacity of about two millions of cubic feet. Greater capacity with a simple bell could only have been secured by deepening the tank; a course which would have been attended by greatly enhanced cost, and on that, as on many another site, by immense difficulties arising from the shifting character of the subsoil. But by the expedient of building up the bell of six telescoping lifts, each of about the capacity of the simple bell for the same tank, the capacity of the holder erected on that tank is increased sixfold. Thus the maximum capacity of the largest holder at East Greenwich is actually over 12 millions of cubic feet. This telescopic construction of the bell is now adopted in all large gasholders, and it has had the effect of reducing immensely the cost of storage of gas. The cost of excavating and rendering impervious to water a tank of 200ft. to 300ft. diameter increases enormously with the depth to which the excavation is carried, unless the nature of the subsoil is exceptionally favourable. Hence it is now the common practice to make the tank reasonably shallow and to multiply the number of lifts in the gasholder. The East Greenwich giant gasholder, designed by Mr. George Livesey, M. Inst. C.E., illustrates the extreme limit to which this practice has been carried. The diameter of the tank is about 300ft., and its depth is only 31ft. 6in. The holder comprises six lifts, each of this depth. The ratio of diameter to height in this tank and holder is well illustrated by a popular simile which emanates from Mr. Livesey. The tank and each lift may be properly represented by a penny piece, and consequently the proportions of the holder when all the lifts are up are those of a pile of six penny pieces laid flat exactly above one another. Owing to the shallowness of the lifts, this enormous holder, which is the largest in the world, and has a capacity of nearly 12,100,000 cubic feet, does not rise to a greater height than do some other gasholders of less than two-thirds its capacity. It represents a departure from common practice in gasholder design, and special precautions had to be taken to guard against the tendency of the inner or first lift to tilt. Only on sites where a shallow tank must be employed by reason of the water in the ground, would it be justifiable to adopt lifts of which the diameter is nine and a-half times the height, as is the case with the lifts of the East Greenwich giant structure. That gasholder was designed by Mr. Livesey to avoid the difficulties attendant on a deep excavation on an unfavourable site, and the unusual precautions taken by him to prevent tilting of the inner lift have proved efficacious. In all other gasholders of considerable size, however, the tanks, and consequently the lifts have been made deeper than in the East Greenwich holder. Owing to the great cost of making a large tank, old single-lift gasholders have in several cases recently been remodelled, and converted into two or three-lift gasholders. The existing tank has thus been made to serve for a gasholder of double or treble the capacity of the one for which it was originally planned,

and increased storage accommodation has thereby been secured without the cost either of excavating a new tank or of securing additional land for it. The enlargement of the No. 5 gasholder at Saltley was carried out on these lines in 1898. The existing tank, and the greater part of the original framing and bell, were utilised, and the capacity of the holder was doubled by the alteration. The work was in many respects so interesting, and illustrates so well the engineering difficulties which such an enlargement presents, that we are glad to be able to give some particulars of the methods adopted by Mr. Hack in this instance.

ELECTRICAL ENGINEERING AT THE PARIS EXHIBITION.

No. VII.

THE NANCY COMPANY.

So far we have chiefly described German and Swiss work; we will now turn to a French exhibit. The Compagnie Générale Electrique, which should have a more distinctive title, had a particularly interesting exhibit. For short we will call it the Nancy Company, as it hails from there; and it is a pretty name. The Nancy Company is only two years old; and its exhibit showed that there is an opening in France for large high-class work. It is astonishing that a company in less than two years can organise itself, and install works, get out designs, and manufacture not merely one thing, but various types of large, direct, and alternating dynamos; batteries, transformers, arc lamps, and, in fact, almost all varieties of electrical plant. Sometimes a concern which has developed a large business in one country starts a branch in another; but in that case the branch has all the experience of the older firm, and probably takes over some trained men, and is provided with drawings embodying the past experience of the original firm in design. The history of the Nancy Company is very interesting. It was formed on the 22nd June, 1898, and it intended from the first to begin by exhibiting at Paris, not one machine, but a whole series of types. In order to carry out this programme the company took an existing works for the meantime, so as to begin work while its own factory was building. At first it began with 290 workpeople, but on the 1st of April, 1900, less than two years after the formation of the company, it employed no less than 500 men and boys.

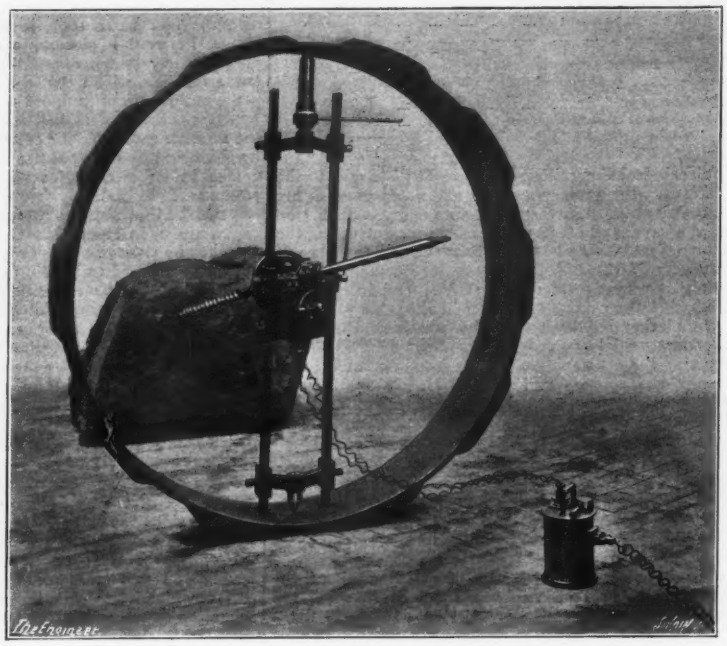


Fig. 1—NANCY ELECTRIC ROCK DRILL

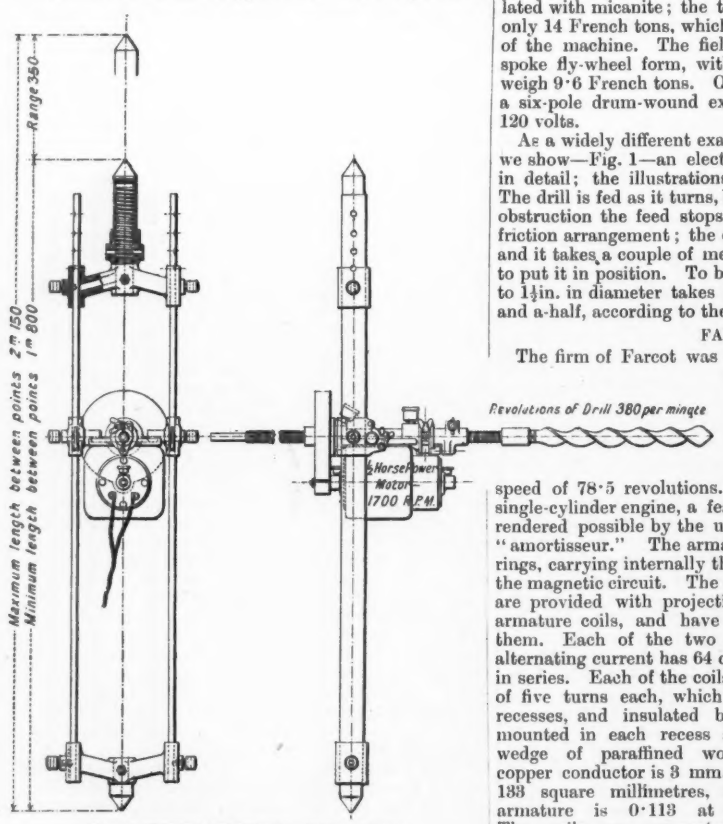

Range 350
Maximum length between points 2m 150
Minimum length between points 1m 800
Revolutions of Drill 380 per minute
5 Horse Power Motor
1700 R.P.M.

Fig. 2—NANCY ELECTRIC ROCK DRILL

The works are at Nancy, occupying about 60,000 square yards. There is a canal on one side, and a railway runs through them; the works themselves occupy 14,000 square yards. The main shop for dynamos, motors, and transformers is 4000 square yards; it is in four bays, each with an electric overhead crane. There are additional buildings for small work, stores, offices, &c.; there is a separate building of 700 square yards for making accumulators. All this is important, chiefly as showing that in France electrical engineering is very much alive. We would be very proud if a works this size were put down in this plucky way by Englishmen in this country. Our works, with certain exceptions, have grown slowly, and when a firm gets more orders than it can fill it groans and sends them away, unless the orders are so insistent that the company is compelled to enlarge.

The Nancy Company exhibited about sixty different machines of various types. Of these we illustrate, on page 567, a tri-phase alternator giving 3000 volts, driven by a Weyher-Richemond engine of 500 horse-power at 90 revolutions. This machine gives 450 kilowatts at a frequency of 50 at 93⅓ revolutions; on a non-inductive load it takes 660 brake horse-power. The armature is built of thin sheet iron, of $\frac{1}{50}$th of an inch, insulated with paper; the whole armature is divided into two semi-circles, and the top half lifts off; the armature is wound with cable so as to give flexibility, and each coil is insulated with micanite; the total weight of the armature is only 14 French tons, which is light considering the size of the machine. The field magnets are of the double-spoke fly-wheel form, with 64 poles; the field magnets weigh 9·6 French tons. On the end of the shaft there is a six-pole drum-wound exciter, giving 75 ampères and 120 volts.

As a widely different example of the work of this firm, we show—Fig. 1—an electric rock drill; Fig. 2 shows it in detail; the illustrations are almost self-explanatory. The drill is fed as it turns, but if it meets with any serious obstruction the feed stops owing to the slipping of the friction arrangement; the drill will fit any size of gallery, and it takes a couple of men some five to seven minutes to put it in position. To bore a hole a yard deep and 1in. to 1½in. in diameter takes from one minute to a minute and a-half, according to the softness of the rock.

FARCOT.

The firm of Farcot was distinguished by its 750-kilowatt two-phase alternator. It had an output of 880 kilowatts, with a power factor of ·85. The full load is 200 ampères on each conductor, the frequency being 42 at a speed of 78·5 revolutions. It was direct driven by a single-cylinder engine, a feat which Messrs. Farcot have rendered possible by the use of the Hutin and Leblanc "amortisseur." The armature consists of two cast iron rings, carrying internally the series of stampings forming the magnetic circuit. The opposite faces of the two rings are provided with projections equal in number to the armature coils, and have ventilating spaces between them. Each of the two armature circuits for simple alternating current has 64 coils of 10 turns each, arranged in series. Each of the coils is divided into two sections of five turns each, which are superposed, mounted in recesses, and insulated by micanite. The two coils mounted in each recess are separated by a triangular wedge of paraffined wood. The section of the copper conductor is 3 mm. by 38 mm. by 5 mm.—*i.e.*, 133 square millimetres, and the resistance of each armature is 0·113 at the working temperature. The coils are connected by small bolts encased in ebonite. The two armature windings are arranged a quarter of a pole one in advance of the other *i.e.*, the spaces between two coils on the one are opposite the middle of a pole on the other. The external diameter of the armature is 6·8 m., and the total weight 60,000 kilos. The field is formed by two rings of cast iron built up of four segments. The laminated pole-pieces are keyed and bolted into seams in the castings. There is one concentric winding, which is arranged between cheeks forming the sides of grooves that run all round the casting, thereby ensuring an energetic ventilation of the casting. The total resistance of the winding is 3·5 ohms, and the current at full load 50 ampères. The total weight of the revolving field without the shaft is 50,000 kilos, of which the winding accounts for 3000 only.

SIEMENS AND HALSKE, VIENNA.

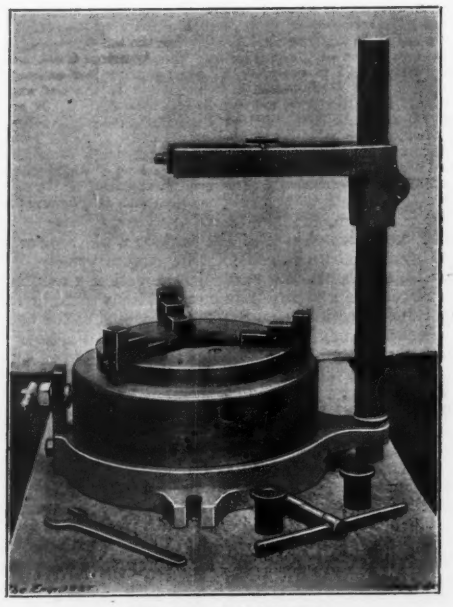
The Siemens and Halske Company, of Vienna, was represented by a number of machines in Class 5. The most important among these is the 1000-kilowatt direct-driven dynamo—the second largest in the whole Exhibition—which supplied power to the general system of distribution. The engine is a triple-expansion engine by Ringhoffer, of Prague, the cylinders being arranged in double tandem; there are one high-pressure cylinder and two intermediate and two low-pressure cylinders. It furnishes 1600 effective horse-power at a speed of 95 revolutions. For its output the dynamo is, owing to its construction, exceedingly compact. The drum armature is 2½ m. in diameter, and 0·54 m. in breadth across the core. In spite of these dimensions the heating is slight, while the commutator and carbon brushes run absolutely sparklessly, with the result that the machine can stand an overload of 30 to 40 per cent. for a short time with ease. A special feature of interest is the Arnold series parallel winding, which has not hitherto been applied to a machine of this capacity. The magnet ring is of cast iron, 3·88 m. in diameter, and has fourteen laminated pole pieces mounted on its interior turned-up surface. To diminish the armature reactions the air-gap has been increased in the direction of rotation of the armature, *i.e.*, it is 7 mm. at one edge of each pole-piece and increases to 12 mm. at the other. The result is that the position of the brushes is very constant for all loads.

Among other objects exhibited is a rotary transformer which, for its size, has a remarkable output. Its capacity is 500 kilowatts at a frequency of 42 and a speed of 600, the armature being 840 mm. in diameter, and 420 mm. broad.

This firm also exhibited a polyphase generator of 85 kilowatts capacity, running at 500 revolutions; and amongst other objects of interest a locomotive for mining work and an electric fire-engine.

FLANGE DRILLING ATTACHMENT.

THE illustration herewith shows a neat device for the rapid and accurate drilling of holes in flanges of pipes, cocks, valves, or small cylinders and covers, &c., without the use of tin-plates, jig-plates, or of any marking off whatever. It consists of a base-plate for bolting to the table of the drilling machine, which carries a revolving disc on which is mounted a universal three-jaw chuck. The base-plate also carries a steel column to which is fitted a cast steel indexed arm on which slides a guide bush. Beside the disc is a vertical indexed arm graduated according to the number of holes required to be drilled in each flange, which can be regulated to drill on any required diameter of circle, subject, of course, to the size of the attachment in use. These attachments are made in three sizes—No. 1 for flanges up to 9in. diameter by 9in. deep; No. 2 for flanges up 15in. diameter by 15in. deep; and No. 3 for flanges up to 20in. by 20in. deep. The periphery of the revolving disc is pitched to suit any division of holes that may be required. For example, No. 2 is suited for dividing from two to sixteen holes inclusive, and the other sizes are suited in proportion. The adjustment of the apparatus and the operation of drilling by its aid are simple operations. Say that in a flange 12in. diameter it is desired to drill nine holes on a 10in. circle; the operator sets the pointer on guide bush to 10in. on horizontal indexed arm; he next sets spring catch at No. 9 on the vertical indexed arm beside the disc. Then the flange, or other article, is placed in the chuck, and drilling commences. When one hole is drilled it is only necessary to raise the drill clear of the work, turn the revolving disc to its next division hole, and proceed as before. The drill once set requires no further adjustment, and it is impossible to run out of its true centre. By means of this neat and well-devised attachment to the drilling table, considerable time is saved, and accuracy of work secured. The makers are John Pollock and Co., 22, Bishop-street, Anderston, Glasgow.



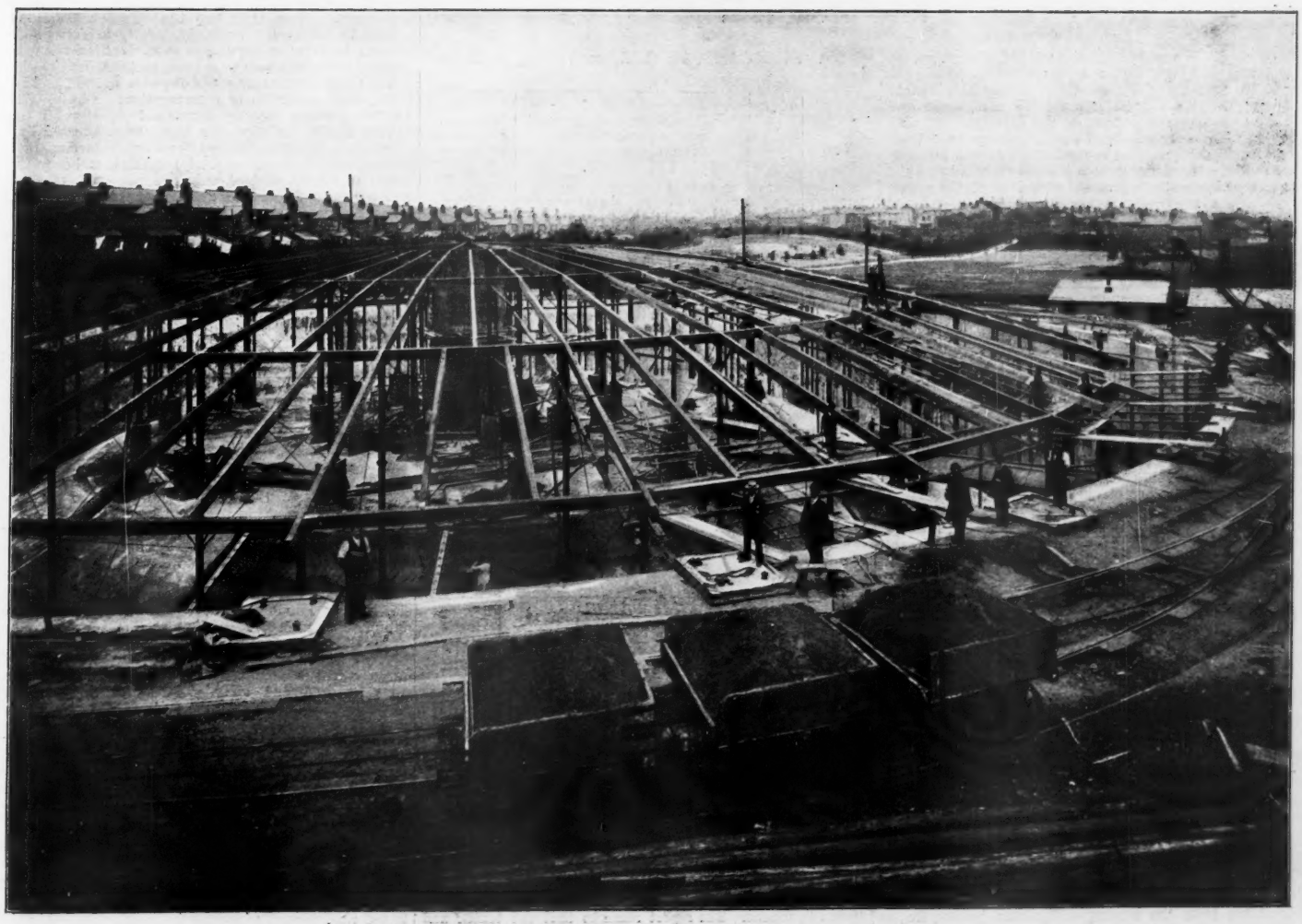
DRILLING ATTACHMENT

FOUR LIFT GASHOLDER AT SALTLEY

MR. HENRY HACK, M. INST. C.E., ENGINEER

(*For description see page 561*)

VIEW OF CROWN DURING CONSTRUCTION

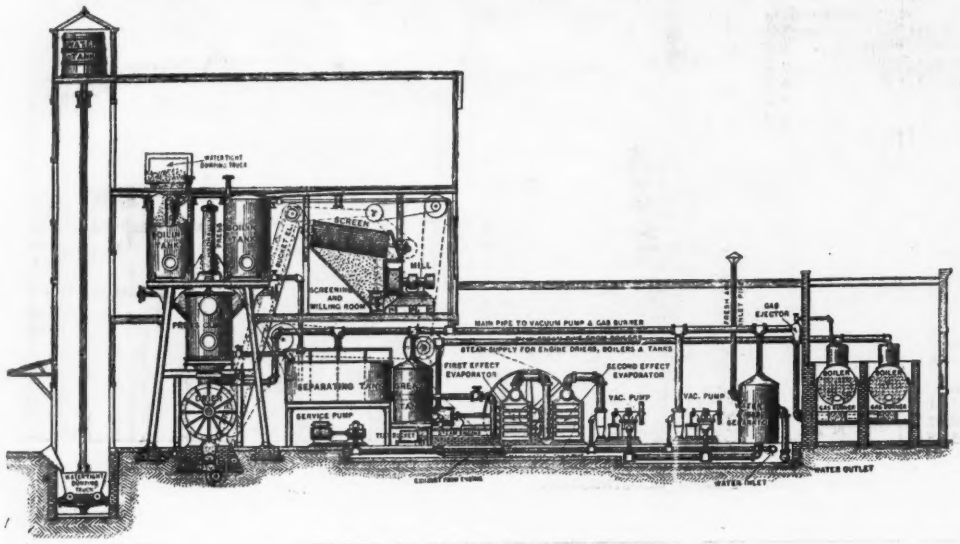


VIEW OF CROWN DURING CONSTRUCTION

REFUSE-DISPOSAL WORKS.

AN interesting description of a garbage or refuse-disposal works at Syracuse, New York, U.S.A., appears in the issue of our American contemporary, *Engineering News*, of October 11th. A short account of these works will, without doubt, be of interest to those of our readers who may not have had the opportunity of reading the original article. The works are constructed on the improved Holthaus system, and were put into operation in the summer of 1898. The main product of the disposal or reduction, as it is called, is the "tankage," which is converted into fertilisers of various grades. There is a large agricultural district in the neighbourhood of Syracuse, which, it would seem, makes this a favourable locality for the manufacture of fertilisers on a large scale, instead of selling the "tankage" to fertiliser makers. The fertiliser branch of the works was started in August, 1899. There was a doubt as to whether it would pay to manufacture on such a small scale, but this summer it was stated that the plant was paying well. In September last year the average daily amount of refuse treated was 30 tons, the total capacity of the plant being 50 tons in twenty-four hours.

The accompanying illustration, reproduced from the article above referred to, gives a general sketch section of the works. They are situated some three miles from the centre of the town. The refuse is collected in wooden barrels, which are taken to the works and emptied into four-wheeled trucks, holding about one ton each. These trucks are lifted on to the second storey of the disposal buildings. Here they are discharged into a movable hopper which can be adjusted to feed either one of several digesters or boiling tanks. These tanks are 5ft. in diameter and 14ft. deep, and are made of ⅜in. steel plates. This thickness is necessitated by reason of the corrosion due to acids and moisture. Cast iron resists this action better than steel, but is less reliable in other respects. Most of the valves used in different parts of the machinery



SECTION OF REFUSE DISPOSAL WORKS

are of cast steel. When the digesters are full, the covers are bolted down, and the refuse is subjected to steam at about 60 lb. pressure for some time. When this "cooking" is over, the grease, or a large portion of it, has melted and drained down to the bottom of the digester. It, with any water which has also drained down, is drawn off. Then a 24in. hinged valve is opened in the bottom of the digester, and the cooked refuse falls through a hopper into a hydraulic press and is subjected to a pressure of 2000 lb. on the square inch, when the remaining grease and water are squeezed out. The press has a false bottom, in the form of a horizontal slide valve, or plate, worked by a chain and sprocket wheel. The hydraulic press cylinder is 10ft. 10in. long, has a bore of 10in., and is provided with a ¼in. copper lining. The piston-rod is 4⅛in. in diameter. From the press the refuse descends into a drier, which is a cast iron cylindrical vessel 12ft. deep and 6ft. in diameter. It is steam jacketed, and in it revolves a large pipe coil, carried on a four-armed spider. Through this pipe steam also passes. The inner shell of the drier is made of ⅜in. steel plates, the outer shell is composed of 7/16in. steel plates, the steam space between them being 2½in. There are no stay bolts, it having been found that the leakage due to these gave more trouble than was compensated for by any good they might do.

After the process of drying is complete, the resulting "tankage" is allowed to fall into horizontal pan conveyors, which empty into a bucket elevator which lifts the tankage into a revolving screen, this being the first time that the refuse has been exposed to the air since being put into the digesters. The screen rejects foreign substances, such as the remains of tins and broken china, &c., and separates what remains into "tankage" and "tailings." The available tailings are ground in a mill and added to the "tankage," which is then ready to be converted into fertilisers.

The water and grease which are taken from the digesters, as already mentioned, added to that which also comes from the hydraulic press, are lifted to three separating tanks. Here the grease is removed by an adjustable skimmer, and passes to a scrubber, where it is washed and cleansed. It is then put into barrels and is ready for sale. The water from the grease-separating tanks goes to evaporators in which exhaust steam is used, the residue obtained being mixed with the "tankage."

The gases and steam from the digesters, driers, and evaporators, are drawn off by means of a gas ejector to a gas tank or scrubber, placed near the boilers. The gases which pass through the scrubber uncondensed are utilised for heating the boilers.

The water for all but boiler uses is drawn from a stream near by, and passes into a settling tank. City water is used for the boilers, and is available as a reserve for all other purposes. A hot well and pump are provided for utilising the condensation from the heating coils, steam jackets, &c., as far as possible. The boilers work at 100 lb., which is reduced to 60 lb. for the digesters. The total boiler capacity is about 180 horse-power. There is a 100 horse-power slide valve engine, and the building is fitted with electric lighting and complete fire-protection systems, including automatic sprinkling apparatus.

We understand that the plant, the mechanical details of which appear to have been worked out with great care, forms the subject of no less than eighteen patents taken out in the name of Cyrus C. Currier, of the firm of Cyrus Currier and SONS, who erected the works for the Syracuse Reduction Company.

THE STRIKES AND LOCK-OUTS OF 1899.

THE report of the Chief Labour correspondent of the Board of Trade—Labour Department—on the Strikes and Lock-outs of 1899 has just reached us, and it is of considerable interest. The Board of Trade are at considerable pains to make these yearly reports as comprehensive and detailed as possible; and, of course, the value of such reports depends in large measure on their accuracy and completeness. As to accuracy, every precaution is taken to ensure this; and as regards completeness, it may be said that the Board have knowledge of practically any dispute of importance which may occur. The present report is the twelfth issued since the commencement of the series in 1888. We learn from it that during the year 1899 there was no trade dispute of such magnitude as to swell unduly the statistics of the year. Indeed, although the actual number of disputes was slightly greater in 1899 than in 1898, neither the number of workpeople affected nor the aggregate duration of all the disputes reached anything like the aggregates of the latter year, or, for that matter, of 1897, though in this particular year the actual number of disputes was much greater. Subjoined we give the figures relating to the last three years:—

Year.	Number of disputes beginning in each year.	Number of workpeople affected by disputes beginning in each year.			Aggregate duration in working days of all disputes in each year.
		Directly.	Indirectly.	Total.	
1897	864	167,453	62,814	230,267	10,345,523
1898	711	200,769	53,138	253,907	15,289,478
1899	719	138,058	42,159	180,217	2,516,416

As a matter of fact, the figures for 1899 are the lowest of any of the six years for which statistics are available for comparison. The next lowest is the year 1896, when the aggregate duration of the disputes amounted to 3,746,368. To quote the exact words of the report, "1899 was a year of settled good trade; changes of wages were in an upward direction, and differences were easily settled without recourse to extreme measures."

In connection with the numbers of workpeople affected, it is interesting to note how these were distributed among the various trades. The following table shows this for 1899, and the two preceding years.

Groups of trades.	Total number of workpeople affected—including those thrown out of work at the establishments affected by disputes, but not themselves directly on strike or locked out.		
	1897.	1898.	1899.
Building	15,047	16,684	30,524
Mining and quarrying	49,392	177,029	46,831
Metal, engineering, and shipbuilding	97,189	21,432	21,119
Textile	57,001	24,978	61,499
Clothing	7,016	3,561	2,258
Transport—dock labourers, railway men, &c.	12,523	3,478	12,611
Miscellaneous	11,734	6 261	4,212
Employés of local authorities ..	365	484	1,163

The mining industry shows the greatest falling off, the numbers affected in 1899 being even less than those in 1897, which up till last year had been the lowest on record. The biggest dispute last year was in the jute trade, with the result that the largest number of workpeople affected was in the textile group, which furnished 61,499, or 34 per cent. of the whole number affected by the disputes of the year. The mining group comes next with 26 per cent., then the building trades with 17 per cent.—which it will be noticed is above the average; and the engineering and metal trades with less than 12 per cent. The report remarks that the textile and mining industries are almost entirely piecework trades, and frequent differences arise not only as to the general rate of wages, but also as to special rates to be paid for work done under frequently changing conditions. The number of persons involved in disputes forms but a small percentage of the total number of persons employed throughout the United Kingdom. The following table bears upon this point:—

Groups of trades.	Percentage proportion of working population in each industry involved in disputes in			Mean percentage. 1894-99.
	1897.	1898.	1899.	
Building	1·8	2·0	3·7	2·4
Mining and quarrying	5·9	21·1	5·6	12·8
Metal, engineering, and shipbuilding .	8·8	1·9	1·9	4·0
Textile	3·0	2·0	4·9	3·5
Clothing	1·2	0·6	0·4	2·1
Printing	0·3	0·1	0·1	0·1
Woodworking	0·8	0·9	0·4	0·7
Glass, pottery, and chemical	1·8	0·8	0·4	1·1
Food and tobacco	0·1	0·2	0·1	0·2
Miscellaneous	0·6	0·2	0·6	0·4
All trades, except agricultural labourers, seamen, and fishermen..	2·8	3·0	2·2	2·9

The year 1899 is in this respect considerably below the average of the last six years, and in no trade is this more marked than in mining and quarrying.

Just as the percentage of people affected is small, so is the aggregate duration of the disputes to the total estimated time worked by the whole industrial population. The aggregate number of working days in a year for a population taken at 8,300,000 is estimated at 2,500,000,000. The aggregate duration of disputes in 1899 was 2,516,416 days, or, roughly, one-thousandth part of the total. There were, as has already been said, a total of 719 disputes. Of these, 416 disputes, or 58 per cent. of the total, involved only 9 per cent. of the workpeople and accounted for only 10 per cent. of the time lost. On the other hand, two disputes alone involved 23 per cent. of the total workpeople affected by all disputes, and accounted for 15 per cent. of the aggregate duration. There was no very large dispute, however, in 1899, and in addition to this the number of days lost was less than in any former year, even when the days lost in the principal dispute in each year are deducted. Thus in 1898 the total time lost was 14,171,478, not counting the 1,118,000 days lost in connection with the engineering strike of 1897. Subtracting the principal dispute, which involved 100,000 men and 11,650,000 working days, the remainder is 2,521,478, which is slightly greater than the 2,516,478 of 1899. Moreover, the aggregate duration of disputes in 1899—with the exception of the building trade and the workmen of local authorities—was less than the average duration for the five preceding years. The absence of big disputes in the mining industry—where a loss of half a million compares with an average of over four and a-half millions for five years previous—in which they are usually so frequent, is attributed to two causes. First, the prosperity enjoyed by the coal trade during 1899; and, secondly, the fact that wages in all the principal districts are now arranged by Conciliation Boards or similar machinery for fixing wages without resorting to strikes. The time lost in the building trade was much above the average, and is due mainly to disputes of a somewhat special character. The general plasterers' dispute accounted for over 200,000 days, and disputes in Yorkshire 150,000, out of a total of 854,207.

Out of 719 disputes, 284 lasted less than one week; 136 lasted from one to two weeks; 108, two to four weeks; 64, four to six weeks; 29, six to eight weeks; 20, eight to ten weeks; 39, ten to fifteen week; 9, fifteen to twenty weeks; 7, twenty to twenty-five weeks; and 23, twenty-five weeks and more. More than half the disputes, therefore, were settled in less than a fortnight, but the average number of persons involved in disputes of short duration was much the same as in those which were more protracted.

The most frequent causes of disputes in 1899, as in former years, were questions of remuneration. Out of a total of 138,058 persons directly concerned in disputes from all causes, 94,651, or 68·6 per cent., were affected by wages disputes. Disputes in resistance of reduction of wages affected only 4·9 per cent. of the total, and disputes as to hours of labour affected only 2·8 per cent. of the whole number engaged in all the disputes of the year. In connection with these remarks the following table is instructive:—

Principal cause.	1897.	1898.	1899.
	Per cent.	Per cent.	Per cent.
Wages	44·1	87·9	68·6
Hours of labour	23·4	0·4	2·8
Employment of particular classes of persons	8·9	4·6	5·9
Working arrangements	17·4	5·8	13·0
Trade unionism	3·8	1·1	3·7
Other causes	2·4	0·2	6·0

The balance of results in 1899 was rather on the side of the employers than of the workpeople, the figures being: In favour of workpeople, 36,808; in favour of employers, 60,275; compromised, 40,237; indefinite or unsettled, 738—these figures representing the numbers of persons directly involved. The 60,275 representing the disputes settled in favour of the employers included 35,000 jute workers who came out on strike for an advance in wages.

The districts affected show certain deviations from the mean of the six years, 1894-9. Thus in the Northern Counties the number of persons affected in 1899 was 9382, as compared with a mean for the six years of 22,290; in the North and West Midland Counties the number was 14,628, against 25,848; in London, 4385, against 8696; in Wales and Monmouth, 37,560, against 48,976; and in Ireland, 2889, against 9147.

Most of the disputes of the year were settled by direct arrangement or negotiation between the parties concerned. Five hundred and sixty-two disputes, affecting 156,743 persons (or 87 per cent. of the total number involved), were arranged by these methods. Only 16 disputes, involving 3319 workpeople, were settled by arbitration; while 22, involving 8386 workpeople, were by conciliation and mediation; 22, involving 7054, by return to work on employers' terms without negotiation; and 88, involving 3980, by replacement of workpeople.

THE exports at the port of Lule of iron ore from the Gellivara mines during the season now closed amounted to 937,175 tons, and that of the Fieja mines to 115,400 tons, or a total of 1,052,575 tons. The exports this year exceed those of last year by 30,083 tons.

DOCKYARD NOTES.

THE business-like fashion in which the Germans are setting to work to permeate their country with naval ideas and aspirations is worthy of admiration on account of its thoroughness. The Christmas toy shops over here bear evidence to one form of activity—the model steamers. We have seen most excellent steam models of the Brandenburg exhibited in British toy shops—presumably surplus German stock. They sell readily, and they fulfil the modern requisite in the matter of toys—a resemblance to the original. Now the puzzle is why no British manufacturer attempts to supply the British market with British ships. It would go far to create an intelligent interest in the Navy in children, and this fact should, in these days of naval enthusiasms, lead to a corresponding sale. From investigations we have made, we are sure that such tin models could be made at a profit over here. Only they must be accurate in detail. By this we do not mean that all details need be put in, but essentials must not be lacking, and a due sense of proportion must be observed. It does not cost any more to put flags correctly or to paint the name in the right place. We shall be happy to make a present to any manufacturer who cares to experiment in this field of advice as to the best ship or ships to select, and any other information that may be required. Such models would go far to create an intelligent interest in naval matters in the young mind, which should bear good fruit in after years.

THE Spaniards appear to have woke up on the matter of naval questions, even if the projected new battleships never get beyond the "projected" stage. They are, we learn, taking the foremasts out of several of their ships, thus following the lead that La Seyne gave over the Greek ironclad Psara. At Santiago falling masts did a great deal of damage in Admiral Cervera's ships.

RECENTLY we mentioned in this column that a rumour was going round to the effect that some of the Belleisle's armour was cast iron, or behaved as such. The naval correspondent of the *Globe* is exercised on this matter. We are glad that he does not mention the source of his inspiration, for his jumbled version of our statement is hardly accurate in a single particular. To begin with—as was fully stated in THE ENGINEER'S special report on the Belleisle experiment—the Majestic never sank the Belleisle at all; she sank from quite another cause. Next, we never said that her armour "is not steel at all." No one ever thought it was. It is always listed as iron, and wrought iron is implied by that. The *Globe* naval correspondent does "not see how it is at all possible to make an allegation of this kind until the armour plates which were struck by the shells of the Majestic have been removed for examination." He is welcome to advertise his ignorance on this matter if it so pleases him, but *cui bono?* An official report made the original statement, that a certain fracture in the armour had all the appearance of cast iron. The fracture was on view for weeks. This is the whole origin of the story. We surmised that the Turks had ordered cast iron on the grounds of economy. The *Globe* naval correspondent says he hopes, "for the credit of British shipbuilding, that some authoritative contradiction may be given," and calls on the builders to give it. The firm that built the Belleisle, we may mention incidentally, ceased to exist many years ago, so how and why they should take up the cudgels anent Turkish ideas of economy we are at a loss to conceive. We have dealt with this matter at some length because we are growing a little weary of "naval correspondents" who use us as a fountain head for information, quote us incorrectly, and then imply that we are untruthful, or scandalmongers.

THE submarine boat for the British Navy is on the *tapis* again, and this time some fire seems to be connected with the smoke. The whole matter is so far shrouded in mystery.

THE officers of the Japanese battleship Hatsusi went round Portsmouth Dockyard last week; those of the Iwate are going round this week.

IN the account of the Borodino class last week the abbreviation "ft." was used in error for inches in the tabular statement. This misprint was, however, no doubt obvious.

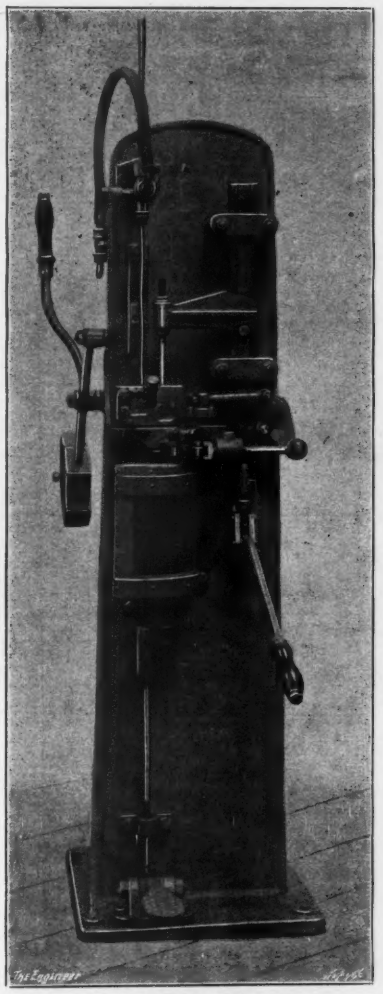
IT is dangerous work to criticise an admiral, but we doubt whether Admiral Sir J. Hopkins will have the Navy with him in his adverse remarks on the speed of our cruisers. All in all, British cruisers make their speeds, and a steady 19 is probably quite as good, practically, as a flash 22 or 23 knots. The Admiralty are already inclined to having their engines too light, and more speed would mean increased lightness of machinery too probably. The reason why the British naval officer thinks an Elswick cruiser better than a British Navy one is not on account of higher speeds so much as because they are fitted with more guns, and rational hoists to these. That is Elswick's speciality. The Idzumo and Iwate are not faster than plenty of our cruisers, they are, indeed, slower than some; it is their guns and armour that make them so good.

A GERMAN gentleman has evolved a new system of reducing all warships to a common denomination. We do not see anything especially useful in the system of Herr Kretschmer, and we sincerely hope no one else will; for the prospect of a new lot of "comparative tables of strength" is terrible. It is very ingenious to reduce chalk and cheese to a common value, but it is not of much service to the man who wants cheese to give him its exact equivalent in chalk. Where ships are concerned the ingenuity is still more wasted, because everything depends upon the use to which the ship is put. Fighting battles is merely an incident in war; and qualities, like draught of water, depend solely upon the conditions of the war. The value of coal supply or consumption, again, depends upon how many and how near colliers or coaling stations are; and an unsteady gunner or a bad stoker will upset the finest system invented.

AËRATED LIQUIDS BOTTLING MACHINE.

OF late years a great deal of inventive energy has been devoted to machinery for bottling aërated beverages. Special attention having been given to increasing the speed of output and preventing waste in production. There is no doubt that the machines as now manufactured are wonderfully perfect in their action, and enable aërated waters and other liquids to be bottled with a rapidity which is almost incredible to those who have had no experience with their working. There were some of these at the recent Brewers' Exhibition, and there were a number of various kinds shown at a small private exhibition of machines of their own make held, concurrently with the Brewers' Exhibition, by Hayward, Tyler, and Co., of Whitecross-street, E.C. Perhaps the most interesting as well as the most novel of these is shown in the accompanying illustration. It is known as Shott's patent machine for bottling aërated beers, &c., and it is an ingenious combination of mechanism, by means of which the bottles are filled with the aërated fluid and corked by the action of one foot and two hand levers. It is perhaps the latest development of this class of machine which has been put upon the market, and it is designed especially for those aërated liquors that are liable to give trouble by frothing, or "fobbing," as it is technically known. It is, however, equally suitable for the best class of soda water.

In bottling aërated liquids, as many of our readers will be aware, certain difficulties have to be overcome. If, for instance, the liquid be allowed to enter the bottle with a splash by reason of the nozzle being only just placed inside the neck of the bottle, much of the gas which it contains is released; and if it be of a frothy nature the bottle is chiefly filled with froth instead of liquid. If, moreover, proper means are not taken for letting off the superfluous gas and the air contained in the bottle, great waste of gas results. If, too, the cork be not properly inserted in the neck of the bottle, it is either crushed or turned up and does not form a perfect stopper. To introduce the liquid into the bottle as quietly as possible it is desirable that the filling tube should be taken to the bottom of the bottle, so that the liquid rises



BOTTLE FILLING AND CORKING MACHINE

in the bottle without splash and drives the air before it. The filling tube has then to be withdrawn and the bottle brought, without escape of gas, into the position for the cork to be driven in. This much had, of course, already been done by former machines, but they required the action of three handles, and as the cork was only compressed by being driven by a plunger through a cone-shaped opening, it was not possible to use long corks for fear of their breaking or turning up at the edges. In the machine from which our illustration is taken the cork is compressed by lateral pressure into about two-thirds of its original diameter before being driven into the bottle, when it expands to its original size. The motions are also effected by two hand levers instead of three.

A glance at the illustration will make the following explanation of the working apparatus perfectly clear. The bottle to be filled is placed upon a bottle-stand, which can be raised and lowered by means of the foot lever, the bottle being protected, as in all machines of this character, by a wire screen. The spindle worked by the foot lever is capable of rotation about its axis, so that the bottle can be easily moved through a small arc of a circle without the pressure being taken off the lever. The neck of the bottle is pressed into an india-rubber cap on the underside of a casting, which is also capable of rotation through a small arc, and which slides against a faced surface of lignum vitæ, or other suitable material carried on the underside of a bracket fixed to the body of the machine. This makes such a good joint that there is no escape of gas between the surfaces. There are two openings in the fixed bracket. Through the left hand of these goes the filling pipe, which, as will be seen, is worked through a link by the weighted hand lever on the left-hand side, passes through a guide, and is connected to the aërated liquid supply by means of a flexible rubber tube. This filling pipe enters the fixed bracket through a stuffing box, and is so arranged that when its nozzle is depressed till it reaches the bottom of the bottle to be filled, the admission valve, which is of the spring type, is actuated by coming in contact with the tappet shown behind the tube and the bottle filled. The air is driven out, as the filling proceeds, through an automatic valve with a regulated spring. The filling completed, the filling tube is raised so that it is free of the bottle neck, but on account of the stuffing-box through which it passes and because of the contact between the fixed bracket and the movable piece already mentioned, there is no escape of gas. Meanwhile a cork has been placed vertically in a recess cut in the fixed bracket. The recess is in the form of a rounded-bottomed V placed on its side. Another V of similar shape, the jaws of which are hinged, is advanced into the first V, the cork being compressed into a perfect circle between the two. This motion is brought about by the right-hand lever, which is also weighted, though the weight cannot be seen, as it is behind the apparatus. This lever performs three separate operations. It compresses the cork as already described; it brings the plunger down upon the top of the cork and eventually drives it into the bottle; and it also revolves the bottle, held as it is after being filled, so that it comes beneath the cork. It will be perfectly evident how these three actions are brought about. The upright slide on the right-hand side is carried in two guides fastened to the frame, and is fastened at its lower end to the hand lever by two short links. Near the bottom, on the right-hand side of this slide, is a slot, into which, when the lever is raised, slides a pin on the pivoted double lever at the right of the slide. A roller on the slide is at this period caught in the hook at the top of the double lever. As the slide descends the pin on the double lever is forced out of the slot, and the roller passes down the grooved side of the lever, with the result that the link which is attached to the top of the lever, and which actuates the cork-compressing mechanism, is thrust to the left, and the cork compressed; simultaneously the plunger descends, and the bottom link is pulled to the right, bringing the bottle—held as it is between the rest and the slide—with it. The mechanism is so adjusted that the plunger is brought to press lightly on the cork before the bottle comes under the cork, so that this cannot be blown out. A further downward motion of the right-hand lever, of course, drives the cork "home." In the illustration the machine is shown in the position it assumes just before the cork-plunger makes its final descent. When the lever is raised again, it lifts the cork-plunger, opens the compressor to receive a fresh cork, and brings the bottle-rest back under the filling tube ready for a fresh bottle. There are interlocking arrangements, so that no part can get injured by the levers being moved in the wrong order.

FOREIGN PLANT FOR BRITISH RAILWAYS.

IN our impression for November 30th will be found on page 546 an article dealing with Sir Howard Vincent's strictures on the Great Eastern Railway directors for ordering rails abroad. We give below two very interesting contributions to the discussion which appeared in our contemporary on Tuesday:—

(*To the Editor of the Times.*)

Sir,—With reference to Sir Howard Vincent's letter and its enclosure in your issue of November 27th, the chairman of the Great Eastern Railway gives as a reason why his company have placed a large order for steel rails and fish-plates with Messrs. Carnegie's Steel Company, that "they had during the past two years two contracts running for rails and chairs with one of the leading rail companies of England, and the final deliveries of the first contract were eleven months in arrear, whilst of the second they had not received a single rail, and that it shows a deficiency of 9000 tons."

Most people will agree with Sir Howard Vincent in saying that "it is difficult to blame those who place orders abroad if they cannot get punctual delivery at home," and no one could reasonably complain that a railway company, under such circumstances, felt themselves compelled to purchase elsewhere, where they could rely on good material and prompt delivery. But would not the Great Eastern Railway Company have attained their ends equally well, and would they not have better consulted the interests of British industries—on which, after all, they depend for their traffic—and the interests of British iron and steel workers—many of whom, although employed only three or four days a week for want of work, are contributing weekly towards the maintenance of the families of their comrades in South Africa—if, before placing their order in America, they had first tried what they could do with the other British makers? It is well within my knowledge that at any time within the last half-year the whole delivery of 9000 tons could have been easily obtained in this country within two months, of a quality or qualities equal to anything that can be obtained either in this country or in America; and as to price, to which the Great Eastern chairman makes reference, although the high cost of fuel for a time placed British makers at a disadvantage with their American competitors, the recent fall in values has afforded considerable relief, it is not now impossible for those who sincerely desire to place orders at home to do so at about American prices.—I am, Sir, yours very truly,

ARTHUR COOPER,
Managing Director of the North-Eastern Steel Company, Limited.

Middlesbrough, November 30th.

Sir,—What can Sir Howard Vincent want? When Lord Claud Hamilton writes and tells him that the iron, coal, and steel trades in this country are in such an exceptionally flourishing condition that all manufacturers are eleven months in arrear with their deliveries, he says, "It reveals an unfortunate state of affairs." This is very remarkable, for on the premises it shows that our industrial population engaged in these trades is in full employment—excepting, of course, the unemployable, a percentage of whom must be always with us, and that employment is held on the very satisfactory terms of their receiving higher wages and working for shorter hours than the operatives of any other country in the world. It is, of course, good to have markets in reserve, but at this present juncture, which Sir Howard Vincent treats as a melancholy one, the opening up to us of all the markets of China, or, indeed, of the world, could give us no more than full work for our operatives at the highest rates of remuneration in the world.

Even Mr. Asquith, at Leeds the other day, spoke of British commercial supremacy as being quite a thing of the past; but if, as I have pointed out, we can have our order books so filled up that we are eleven months behindhand with our deliveries, and our artisans are by far the best paid in the world, whatever we may fear in the future, are we not maintaining our supremacy now?

I am quite aware that, owing to the temporary irresistible tyranny of trade unionism, pending counter combinations on the part of the employers, the profits of production are not being divided in the same proportions as they used to be. Indeed, one may say that capital and the brain labour of organisation are being "sweated," but that does not affect our position as a nation in rivalry with other nations, but is a matter for internal struggle and adjustment. I fear I have digressed from my first question, and will only say that it would be interesting if Sir H. Vincent would anatomise his melancholy a little, and let us know where the misfortune lies.—Yours obediently, GEORGE T. HARTLEY.

Wheaton Aston Hall, Stafford.

LABOUR TROUBLES.

THE strike of the Cannock Chase enginemen has come to an end. At a meeting last week of coalowners and representatives, held in Walsall, a satisfactory arrangement was brought about. Winders to receive the same wages as before handing in their notices, with the addition of 2d. per day in lieu of the advance proposed for January and February; hours to be reduced to ten, and overtime paid for at the rate of 6d. per hour; Sunday wages to be the same as before. Stokers, pumpmen, fanmen, and boiler minders to receive an advance of 3d. per day, and an allowance of 1s. per double turn at week end, to be paid where the men are working full turns of twelve hours. The agreement contained also an exceptionally worded clause:—"That the collieries are willing to take everyone back who has not been guilty of misconduct, and will reinstate them at their former positions where possible." Work has now been resumed, and the strike is ended.

A novel strike is stated to be in process of development. Thirty thousand London carmen are formulating a proposal that they should be licensed the same way as cabmen and busmen. A few more meetings are arranged, and if, after a reasonable time, no satisfactory reply is received, a general strike affecting London and suburbs is to follow. On Wednesday it was stated that a substantial advance of wages had been made in several cases, the men resuming work. The probability is that the agitation will subside.

At Cardiff, Penarth, Barry, and Newport considerable dissatisfaction exists amongst the coal trimmers and dock labourers at the late action of the colliers. Without any consideration except for themselves, they took a day's holiday, which affected the work of several days in addition, and seriously injured the complainants, many of whom simply live from hand to mouth.

A movement in connection with the Great Eastern Railway dispute took place on Sunday last at Stratford, when a meeting was held by the trades and organisations of West Ham, Poplar, and the district, to protest against the dismissal of Signalman Unwin by the Great Eastern Railway. The chair was taken by Mr. Lane, of the Amalgamated Society of Engineers. In the course of the meeting Unwin spoke at some length, and also Mr. Keir Hardie, M.P. The latter referred to the course taken by Lord Penrhyn and Lord Claude Hamilton, and at the conclusion of his speech maintained that the working man was master of the situation, and that the time was coming when public recognition would be made of the fact that the railway and the quarry were for the convenience of the public, and not merely to make dividends for capitalists.

Efforts have been made by Press representatives in North Wales to obtain an interview with Lord Penrhyn, the great public importance of the quarry dispute, which threatens to ruin the district, justifying every moral effort; but Mr. Young, the chief manager, replies that his lordship is averse to a personal discussion, but that it might be taken for granted that the interviews of pressmen with himself took place with his lordship's full knowledge, authority, and approval. Asked whether, in the event of the men appointing a deputation to lay grievances before him, he would guarantee that they should not suffer in connection with their employment, he refused to give any guarantee that a man should not be discharged if he broke the rules of the quarry. He was confident that if the men overcame their prejudice in favour of monthly bargains, as at Festiniog, it would be vastly to their benefit.

On Saturday the manager issued an appeal to the men, stating that he had been instructed to again offer them work, adding that the quarry officials would be in attendance on Wednesday, upon which day all who had accepted their bargains on November 19th might return with their tools, &c. The manager also intimated that he was authorised to close the quarry in the event of there being any further disturbance.

It is now inferred that his lordship is very desirous of a peaceable ending. The extent of the great industry will be seen from the fact that the last fortnightly pay, made on Saturday, amounted to £17,000, and this was only half the usual amount.

For some time there has been a degree of suspicion in the public mind with regard to railway arrangements that favouritism was shown, and that the table of rates would, on occasions, be made elastic. This was hinted at lately in a public inquiry concerning several of the railways of South Wales, when one of the managers frankly admitted that their coal expenditure was much less than it would otherwise have been, as they had arranged with leading collieries to give lower rates in return for coal at less than ordinary price. This may probably lead to discussion. At present coal factors and merchants are up in arms against the Midland Railway Company, it being alleged that a secret rebate agreement has been entered into between the railway and Rickett, Smith, and Co., and involving a sum of half a million sterling. Under the agreement, it is stated, the railway company allows Messrs. Rickett 1¼ per cent. on all sums paid by them to the company for the carriage of coal.

The other factors and merchants declare that both they and the other railway companies have long suspected the existence of such an agreement, but on taxing the Midland have met with a denial. They now demand retrospective compensation—something like half a million—for the preference which has not been accorded them, and the Society of Coal Merchants is understood to be on the eve of taking action in the matter.

The factors contend that the position of the Midland is untenable ever since the passing of the Railway Act of 1888.

Mr. Turner, of the Midland, denies that the agreement was a secret one. When questioned he showed the correspondence, and offered Booth and Co. the same terms. It was not a rebate, but a discount at 1¼.

One of Mr. Turner's statements, quoted in the *Daily Express*, is as follows:—"The complainants came to me upon the matter, and I frankly admitted that there was an agreement, offering them the same terms if they would supply coal on the same conditions." This point of the *quid pro quo* appears to have been overlooked by the London journalists. This would bring the Midland in line with the Welsh railway to which reference has been made."

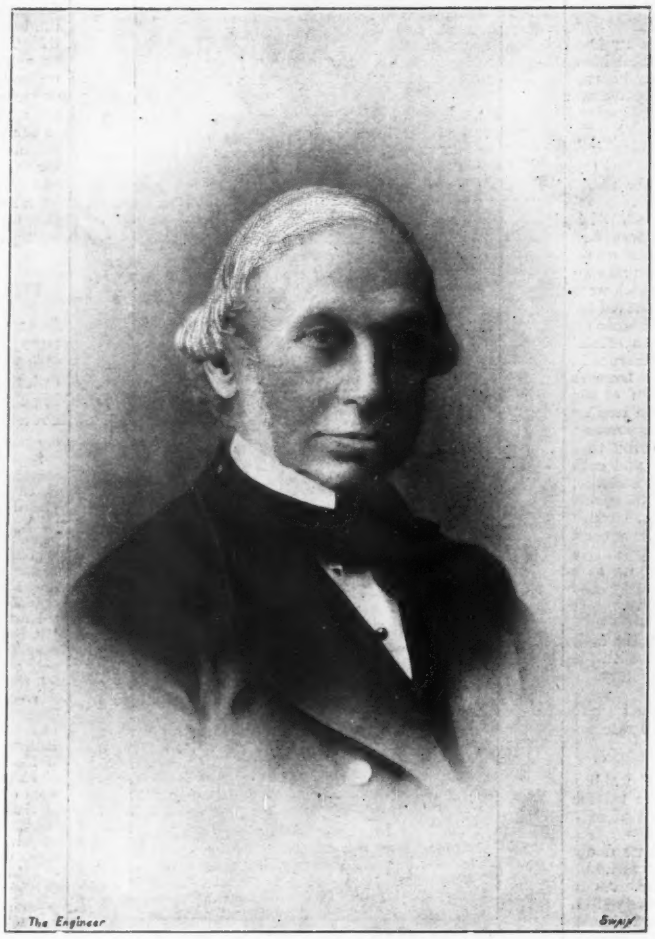
The public inquiry now is—the London public in particular—Are the private arrangements between railway companies and coalowners such as to maintain the prevailing high coal prices in the City? Upon this head interesting evidence may be forthcoming. The present high wages of colliers have temporarily suspended an agitation to elicit the reasons why coal, cut at a few shillings per ton, sells in London at 30s.

Intimation has been given by Mr. A. Thomas, one of the Welsh members of Parliament, to a resident at Bethesda, that employment for at least a thousand of the North Wales quarrymen could be found in the county of Glamorgan at once. The strikers have not waited for invitations, but are flocking to all parts of the colliery district and are finding employment. At Dowlais this week a large number was put to work. These are principally engaged on rocky veins, and in driving headings, and places where the drill to which they are used is necessary.

The Daran and Brynmenin men, Garw Valley, have decided to put in notices unless at the end of the month the dispute now pending has been arranged.

The law on picketing is now to have further elucidation. Notices have been served of appeal to the House of Lords against the recent judgment of the Court of Appeal. It is to be heard in due course.

The Taff Vale strike may now be regarded as effectually settled. This week one of the strikers, who had been tried for assault three months ago and ordered to come up for decision, presented himself, and was discharged, the police having no evidence against him.



CHARLES SELLS

JOHN T. KING.

WE are sorry to have to announce the death of Dr. King, aged 66, on his estate near Ruthin. In Liverpool few men were better known or more thoroughly respected. He was a man of fine presence, charming manners, and considerable talents. He was a patent agent by profession, but he was much more than this. He attained a high reputation for the conduct of patent trials; and was an excellent lawyer within limits. Many of our readers will, however, remember him best for the important part which he played in the introduction of the Westinghouse brake into this country. It is not, we think, too much to say that to Mr. King that introduction was in the main due. The brake must, of course, have come in any case; but its introduction was enormously accelerated by his indefatigable exertions. For some years he had largely withdrawn from professional work. He was much interested in the shipping of the port, was managing director for years of the Bacon line, and one of the largest shareholders at one time of the Houston line. In another department altogether he was known as a breeder of pedigree cattle and sheep, the prizes he has taken being almost innumerable, and the stock upon his estate was second to none in the kingdom. The farm was always kept up to date. He was one of the first to make the Liverpool Polytechnic Society the success it was for years; and the good it has done is shown by the numerous flourishing societies that have sprung from it.

CHARLES SELLS.

THE death of Mr. Charles Sells in his eightieth year removes one more of the pioneer engineers of the nineteenth century. His death will be regretted by a very large circle of friends and acquaintances.

In 1837 he entered the establishment of Messrs. Maudslay, Sons, and Field as a pupil, and steadily rose in the estimation of the partners, who were not slow to recognise talent. In 1847 he became head of the drawing office, and for many years he had sole charge of the designing department of the works. During all this time the firm were in the very zenith of their fame. The list of the work for the designing of which Mr. Sells was responsible would fill columns of THE ENGINEER. He was the inventor of the return piston-rod horizontal marine engine, which might be regarded as the reply of the Lambeth firm to the trunk engine of Penn. Indeed, much of the best marine work of to-day is but a replica of his designs.

Nothing in the way of work came amiss to Charles Sells. He designed and saw constructed dredgers for the Swan River, Naples, the Danish Government, Copenhagen, Calcutta, Pernambuco, Adelaide, and Amsterdam among a multitude. He designed the machinery for the mints of Constantinople, Bombay, Bogota, Columbia, China, London, and many other places.

He designed, it is probable, more marine engines for the Governments of Great Britain and other nations than any other man who has ever lived, and a special feature about his designs and Maudslay's work was that there were never any failures.

About 1861 he took out his patent for reversing by gearing, a very beautiful invention, which was fitted to several ships, among others the Roma and Venitia, of the Italian navy. A notice of this gear will be found in THE ENGINEER, page 574, for June 17th, 1898.

Mr. Sells was far from being wedded to old-world methods. On the contrary, he was always ready to move with the most advanced men, but he was never rash, and this was one reason why he was so successful.

PNEUMATIC TOOLS IN RAILWAY SHOPS.

IN a lecture on this subject, before the St. Louis Railway Club, U.S.A., the following particulars were given of individual cases in which these tools have been used to advantage:—

(1) A saving of 67 per cent. in riveting the mud ring on a Consolidation locomotive by the air hammer over the cost of riveting by hand.

(2) Chipping by one man on a ten-wheel engine in half a day with a pneumatic hammer, that would require the labour of a boilermaker and helper two days.

(3) Saddle drilling by a machinist and helper in three hours that would have required sixteen hours with the ordinary ratchet drill.

(4) Work in Chicago railway boiler shops with pneumatic breast drill, that required less than one-tenth of the time ordinarily consumed in doing the same work by hand tools.

(5) Chipping out defective stays in three hours by an apprentice boy, that would have required a skilled boilermaker a full day in the old way.

(6) Beading 250 flues with a pneumatic hammer at a cost of 2s. 6d. that ordinarily cost 10s.

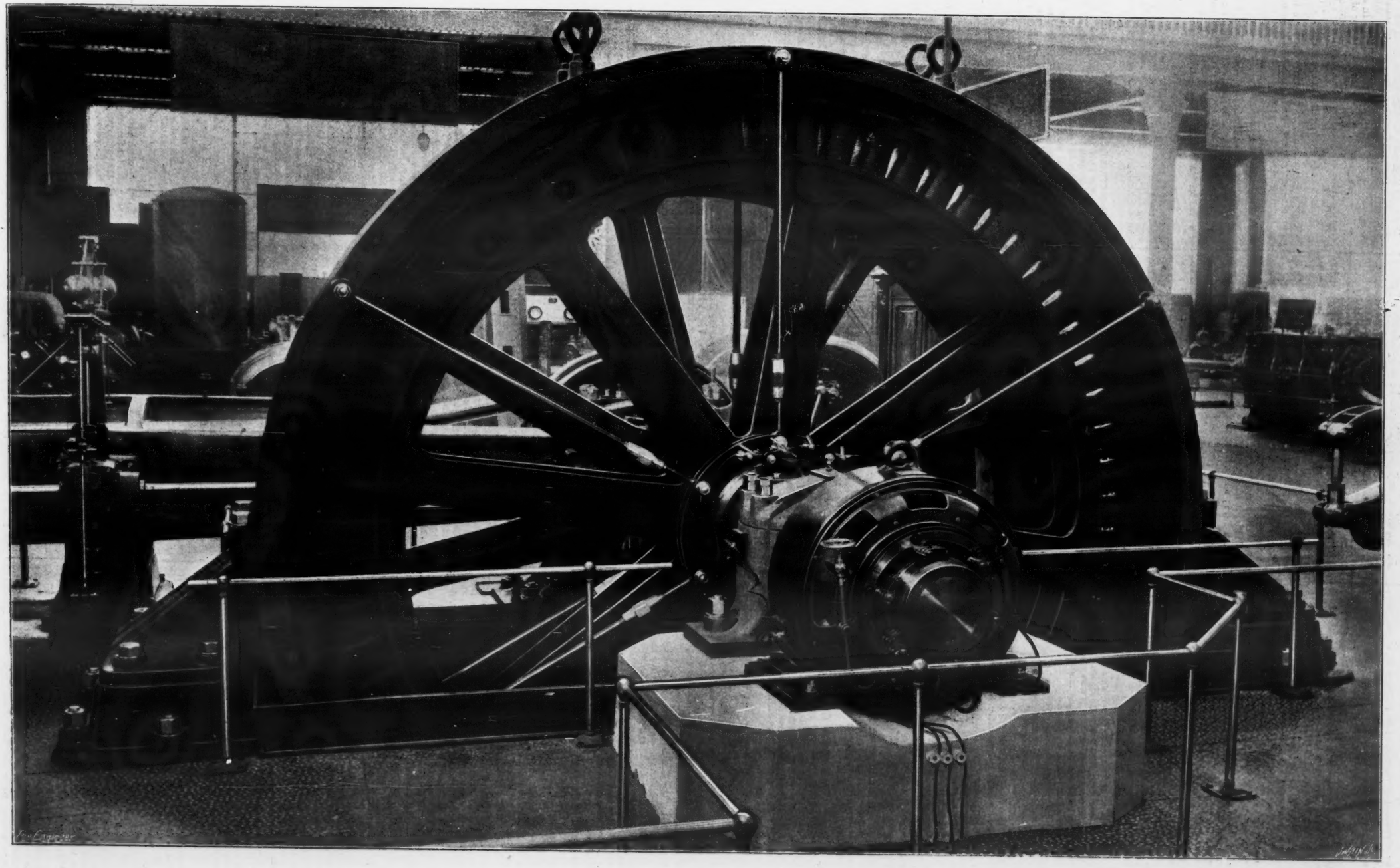
Tool and general character of work.	Saving. Per cent. of cost.	Per cent. of time.
Pneumatic hammer, general foundry work (chipping)	67 to 75	67 to 75
" riveting on mud ring and on fire-box	67	—
" chipping flue sheet	84	75
" beading flues	75	75
" general boiler-shop work	60	—
" cutting out broken fire-box stays	70	70
" cutting off stay-bolt heads	58	—
Riveter, boiler riveting	66	50
Drill, drilling saddles	70	70
" in general machine-shop work	75	75
" drilling for stays	50	50
" in general boiler-shop work	75	75
" facing steam pipes	75	75
" tapping for stays	65	—
" reaming crown sheet	70	—
Breast drill, general work	90	60
Stay-bolt nippers, cutting off stays	78 to 90	75 to 90
Driving-box press, pressing brasses	68	—

THE work on the line of railway which is to connect Athens with Thessaly is to be commenced before the end of the year.

THE PARIS EXHIBITION—500 HORSE-POWER GENERATOR

THE COMPAGNIE GÉNÉRALE ÉLECTRIQUE, NANCY, ENGINEERS

(*For description see page 562*)



RAILWAY MATTERS.

A SPECIAL system of points, to be worked by electricity, is now being introduced at the Nikolas passenger station in St. Petersburg, and it is hoped that this new system will largely reduce risk of accidents.

IT is announced officially in the Russian Press that the general administration of the Russian railways is having built 1000 fourth-class railway carriages for the coming year. These carriages will be reserved entirely for the use of workmen.

A LOOP line has been opened this week at Pontypridd, connecting the Taff Vale Railway with the Rhondda, for mineral trains. This will enable the Taff Vale to proceed with the great extensions, erection of bridges, &c., now being carried out.

THE item "Lloyd's Bonds," which found a place in many railway balance-sheets thirty years ago, is now almost as extinct as the "dodo," says the *Railway News*, the Chatham Company and the Great Central Company being the only important companies with this particular form of liability.

STRONG opposition has been raised by the Kew Observatory officials to the construction of a new electric tram line from Richmond to Acton, which is now in progress. A formal appeal has been made by the Astronomer Royal and other leading professors to the Board of Trade, which has the matter now under consideration.

THE plant for generating the electric power for operating the sixteen miles of tramway route from Shepherd's Bush to Acton, Chiswick, and Kew, Brentford, and Hounslow, belonging to the London United Tramways Company, is now about ready. The power station is at Chiswick, and the machinery includes three 1000 horse-power steam engines.

A PRIVATE company, in which it is said English capitalists are interested, has just been formed at Kieff for carrying out the project of building two lines of railway; one line will run from Kieff to Slobin, and the other from Kieff to Chernigoff and Briansk. There is also a project of constructing a bridge across the Dnieper, twenty miles above Kieff.

THE construction of the permanent way of the branch line of the Central Asiatic Railway to Bokhara was completed at the end of last month. The line, which is twelve versts long, is being built at the Emir's expense, and is to be finished by the beginning of next year. It is estimated that the goods traffic over the line will amount to 6,000,000 poods annually.

THE report of the Bengal and North-Western Railway for the half-year ended June 30th last, presented at the meeting held in London on the 4th inst., states that the length of line open to public traffic is 1118 miles, of which 743 belong to the company and 375 to the State. It is hoped that the Tirhut extensions will be opened throughout early in January with diversions at the Kosi and other large rivers.

THE railway system of the Government of Kherson, N.E. of Odessa, has been enlarged of late. The line of railway between Kriukov and Koselskoye is nearly completed, and will probably be thrown open to general traffic early in next year, although only goods freight may then at first be carried. A start has been made in constructing a railway from Koselskoye to Dolginzevo and Grushevka.

THE report on the working of the Pittsburgh and Western Railroad for the year ended June 30th shows how the weights hauled by goods engines have increased lately in the United States. The average number of tons per freight-train mile on standard-gauge lines was 477 in 1899-1900, against 419 in 1897-1898, and the average revenue per mile of freight train, 2.45 dols., against 1.86 dols. in 1897-1898.

A FAST run on the Canadian Pacific Railway was made on November 12th, with a special train carrying Lord Strathcona from Montreal to Ottawa. The train left Montreal at 8.37 a.m., and reached Ottawa at 10.27 a.m., making a distance of 111·4 miles in 110 minutes. It is stated that at least ten minutes should be deducted from this, however, for slow running through busy parts. The train consisted of Atlantic type engine, one coach, and a private car.

ACCORDING to the Central News, it has been decided to push forward the railway from Buluwayo to the Wanki district, where a great coal discovery has been made. This new line will form part of the Cape to Cairo Railway. Wanki lies about 200 miles to the north-west of Buluwayo. It has been found that the Zambezi can be much more easily crossed at this point than at the part originally provisionally selected much further to the east, in addition to affording facilities to the new coal mines.

THE first electric train has been placed upon the Second-avenue line of the Manhattan Railroad in New York for trial. It is made up of four ordinary cars and two motor cars—one at each end. Each of the latter is equipped with four 100 horse-power motors; this is equivalent to a total of 800 horse-power, or four times that of the locomotive now in use. As there is an operating cab at each end of the train, there will be no shifting or delay at terminals, as the train will start back as soon as loaded.

IT is announced that the North-Eastern Railway Company will apply in the next session of Parliament for running powers to Edinburgh and Leith. At present the North-Eastern has an agreement with the North British Company to run the "Flying Scotsman" between Berwick and Edinburgh, but the English company, we understand, now seeks to place its own servants at North British stations, and work its own rolling stock over the Scotch company's portion of the East Coast route between England and Scotland.

AT last week's meeting of the London County Council it was decided, on the recommendation of the Highways Committee, to approve the underground conduit system of electric traction, which has been devised by Professor Kennedy, for use on the tramways between Westminster Bridge-road and Tooting, Kennington Park and Blackfriars Bridge, and between St. George's Circus and the terminus in Waterloo-road. In order that the work might be proceeded with as early as possible, the Council resolved to forward the description and drawings of the system to the Board of Trade for approval, and to send copies to the Borough Councils interested.

THERE are numerous complaints from occupiers of buildings in proximity to the Central London Railway regarding the inconvenience and annoyance which they suffer from vibration due to the traffic on this line. In some shops the tremor is said to be so great that goods, such as crockery, are caused to rattle with the passage of trains, and in other buildings cracks are said to have been caused in the walls. Such complaints as the above, with the possibility of legal troubles ahead, are sufficient to cause serious misgivings regarding the prospects of early dividends. It is suggested that the vibration would be remedied if the locomotives were provided with springs between the axles and bodies.

THE result of the running of the London and Edinburgh expresses under the new timing, under which the journey has been nominally shortened by fifteen minutes, has not so far shown the East Coast route to advantage. On Saturday the Flying Scotsman arrived in Edinburgh twenty-eight minutes later instead of fifteen minutes earlier, while the West Coast train reached Edinburgh seven minutes before the accelerated time. On Monday night the East Coast express improved considerably on its Saturday running, but it was still seven minutes late. The West Coast express left Carlisle punctually to its scheduled time and, making up six minutes, arrived in Edinburgh at nine minutes past six instead of a quarter past.

NOTES AND MEMORANDA.

IN America engineers who make a speciality of water works are called "hydraulicians."

THERE are 362 private Bills deposited for the consideration of Parliament. They include 46 railways, 26 tramways, and 103 electric lighting Provisional Orders.

IN the month of October 3096 vessels, measuring 531,701 register tons net, used the North Sea and Baltic Canal, against 2669 ships and 385,176 tons in October, 1899. The canal dues collected, after deduction of the Elbe pilotage money, amounted to 263,140 marks, against 209,211 marks.

FOR the year so far there have been put into the water in the United Kingdom 541 vessels, of about 1,259,014 tons gross, as compared with 598 vessels, of 1,323,665 tons, in the first eleven months of last year; 653 vessels, of about 1,293,563 tons gross, in 1898; and 601 vessels, of about 911,569 tons gross, in 1897.

A NOVEL form of reflex water-gauge, intended chiefly for motor car purposes, is being made by Richard Klinger and Co., London. It is constructed of aluminium, and has a sight glass. The intention of the manufacturers is that it should be inserted in the water-cooling circuit, so that the driver can see at a glance whether his water supply has given out.

RECENT explorations in German East Africa have led to the discovery of mica of good quality. In spite of the difficulties of transport which have to be encountered in connection with the exploitation of the East African mica, until the projected central railroad approaches the Uluguru mountains, the process of mining the material might already prove remunerative.

H.M. CRUISER Hyacinth left Plymouth on Monday for a four hours' full-speed trial. According to the *Times*, she had no difficulty in maintaining a mean of 10,000 indicated horse-power, but the speed was only 19·7 knots. A heavy sea was running in the Channel, and this, together with the fact that the vessel has not been docked for some time, probably accounts for the comparatively low rate of speed.

ONE horse-power hour is required to produce 0·3 of a pound of calcium carbide of good quality. The great power necessary has led to calcium carbide being produced only where there is abundant water power, as at Niagara. The cost of a horse-power at this place is about £3 12s. per electrical horse-power per year, and at this rate calcium carbide may be purchased in large quantities at from £15 to £16 per ton.

A FAIR idea of the profitable nature of coal mining during the last two years or so can be gathered from the figures given with regard to the increased profits earned by a Northumbrian company, which has just been converted into a limited liability concern. In 1898 it is said to have profited to the extent of £31,118, in 1899 the profits rose to £55,601, and for the current year they are at the rate of about £95,000.

DURING last month Scotch shipbuilders launched twenty-eight vessels, of about 63,420 tons gross, against twenty-six vessels, of 41,497 tons gross, in October, and twenty-five vessels, of 39,876 tons gross, in November last year. For the year, so far, Scotch builders have launched 287 vessels, of 461,602 tons gross, against 443,272 tons gross in the corresponding period of last year, 409,948 tons gross in 1898, 298,207 tons gross in 1897, and 366,221 tons gross in 1896.

THE President of the Board of Education has appointed a committee, consisting of Sir William de W. Abney, K.C.B., F.R.S. (chairman), Sir Philip Magnus, Sir Swire Smith, Mr. G. R. Redgrave, Mr. W. Bousfield, Mr. W. Vibart Dixon, with Mr. A. E. Cooper, Board of Education, South Kensington, as secretary, to consider the best means for co-ordinating the Technological work of the Board of Education with that at present carried on by other educational organisations.

RETURNS have just been issued showing the production of gold, silver, copper, and tin, and the exports of coal, by the Colony of New South Wales, during the first nine months of this year. The amount of gold produced was 263,710 oz., valued at £912,648. The quantity and value of the silver, copper, tin, and coal exported during the September quarter were as follows:—Silver, ingots and matte, 216,277 oz., £25,331; silver-lead and ores, 113,300·5 tons, £663,755; copper, ingots, matte, and ore, 2088·1 tons, £130,855; tin ingots and ore, 503·6 tons, £67,502; coal exported to foreign and inter-colonial ports, 926,503 tons, £351,228; representing a total value of £1,238,671, and an increase of £181,193 over the preceding quarter.

TO promote the industrial use of alcohol, the French Government appointed a committee some time ago to report on what changes should be made in the method then in use for "denaturing" alcohol, or rendering it non-potable. This committee now recommend that the addition of methyl alcohol should be reduced from 10 per cent. to 1 per cent., and that the use of malachite green, a non-volatile material, now in use as a denaturant, should be abandoned. The mixture they suggest as meeting the requirements of the various industries, whilst adequately protecting the Treasury, is made up of 97 volumes of alcohol at 95 deg. on Gay-Lussac's hydrometer, one volume of methyl alcohol, one volume of wool-washer's grease, and one volume of heavy benzene.

THE report of the experts sent out by the British South Africa Company to inquire into the reported find of coal in Rhodesia practically confirms the original statements made with regard to it. The coalfield is situated some 180 miles north-west of Bulawayo, and is known to extend over at least 400 square miles. The seams vary from 5ft. to 16ft. in width, and as the coal lies within 40ft. of the surface it will be worked by means of inclines instead of shafts. It is estimated that at least 1,500,000,000 tons will be available after making an allowance of 20 per cent. for loss. The experts declare that the coal is better than that now in use in the Transvaal, Natal, and Cape Colony, and in some cases compares favourably with the best Welsh coal.

THE Colonial-office has issued a statement that the Pacific Cable Committee have accepted on behalf of the Government, and of the Governments of Canada, New South Wales, Victoria, Queensland, and New Zealand, the tender of the Telegraph Construction and Maintenance Company for the manufacture and laying of the projected Pacific cable. The amount of the tender is £1,795,000, and the work is to be completed by the end of 1902. The cable will extend from Vancouver to Queensland and New Zealand, *vid* Fanning Island, Fiji, and Norfolk Island. The total length will be considerably over 7000 miles. The portion from Vancouver to Fanning Island will be the longest in existence, namely, 3500 miles.

ALTHOUGH not such a severe test of the merits of a motor car as at first sight it might appear to be, the performance of the two Decauville carriages on the Crystal Palace cycle track a fortnight ago deserve to be placed on record. One carriage was propelled by an 8 horse-power petrol engine, and the other by a 5 horse-power engine, both water-cooled. The former completed 1000 kiloms (621 miles) in 24 h. 54 min. without a stop, giving an average speed of 24·93 miles per hour, and the latter 1000 miles in 48 h. 24 min., without stopping the engine, in this case the average speed being 20·66 miles per hour. The Decauville carriages in several long-distance events have proved themselves to be of sound construction, and to have durable wearing parts. Perhaps the greatest objection which has hitherto been urged against them is the noise made by the bevel gearing. This, we understand, is now largely reduced by casing in the gear wheels.

MISCELLANEA.

WE hear that Geo. G. Blackwell, Sons, and Co., Limited, of Liverpool, has made an important step in the production of a very high percentage ferro silicon containing 22 to 25 per cent. of silicon.

THE London County Council is about to make an experiment in the use of oil fuel for one of the fire brigade vessels on the Thames. The apparatus which will be adopted is that of the Clarkson and Capel Steam Car Syndicate.

WHILE crossing from Barrow to Belfast last Friday night, the mail steamer Manx Queen was completely disabled by the fracture of the main engine shaft. In the early hours of Saturday morning she was towed into Morecambe Bay. The Manx Queen is a paddle steamer.

A COMPLETE working installation of Marconi's wireless telegraphic apparatus will be installed at the Essex Manufacturers' Exhibition to be held at the Shire Hall, Chelmsford, from December 12th to 14th next. The Exhibition is being promoted in aid of a fund for the Essex disabled soldiers.

IN discussing the proposed Shipping Subsidy Bill in the Senate at Washington, Senator Frye stated that it cost 80 per cent. more to run American than it did to run British or Norwegian ships. Of all the enormous exports and imports of the United States last year only 9 per cent. was carried in American bottoms.

A TREATY was signed at Washington last week by Mr. Hay and Sir Luis Correa, the Nicaraguan minister, by which Nicaragua concedes to the United States the necessary rights and privileges within her bestowal for the construction of the projected Nicaraguan Canal, including the free use of the San Juan River and Lake Managua as part of the canal's course.

A HORSE was killed at Sunderland on Saturday by a curious incident. A telephone wire broke and lay across the trolley wire of the electric tramways whence one end of it fell to the ground. It is stated that the animal trod upon the wire and received a shock which stunned it and caused it to fall on the wire, whereby it received a further charge through its body. All the telephone wires are being placed underground.

Fairplay hears that the Czar's yacht Standart, which is fitted with Belleville water-tube boilers with economisers, is to have the economisers taken out of her, as they are not considered to be necessary to the efficiency of the boiler. The Russian battleship at present building at a French Mediterranean yard has had the order for economisers to be fitted with her Belleville boilers cancelled, and the boilers will be supplied without them.

THE use of acetylene gas is growing in Buenos Ayres, where several shops have been furnished with the necessary apparatus. A large calcium carbide factory has been established about two kilometres from Cordoba. In the main building there are five carbide melting ovens, as well as the machinery for crushing the raw material. There are also works for making metal vessels to receive the manufactured carbide, packing rooms, &c. There is a plentiful supply of limestone of high quality in the neighbourhood.

AT a meeting of the Leith Dock Commission, held a few days ago, a statement was submitted in regard to the works which the Board had sanctioned. These include the completion of the new dock, the erection of sheds and equipment, the construction of the extension of the dock and of the graving dock, the completion of the electric light installation, the erection of landing appliances for the grain trade, improved coal-loading facilities, &c. The total estimated cost of these works is £307,000.

WE learn that the Lanarkshire Bolt and Nut Company, Limited, has had plans passed at the Dean of Gild Court, Hamilton, for large additions to the present works at Greenfield. The extensions will cover nearly an acre of ground, and the cost will be about £15,000. The company is putting down the most modern machinery to make all sizes of bolts, nuts, and rivets. When the new works are completed, the output will be something like 600 tons per month, and the number of employés will be increased by 300.

SPECIAL efforts are about to be made by the naval recruiting officials to secure desirable candidates for service in the Navy as engine-room artificers. Since April last 200 of these ratings have joined the service, but the number, says the *Western Morning News*, is still a hundred short of the required strength. Although there is a dearth of artificers, there has been no difficulty in getting stokers; in fact, so many have been entered during the past six months that the Admiralty have ordered the entry to be temporarily discontinued. Since April last just eleven hundred stokers have joined the Navy.

As the result of the experience gained by the War-office in South Africa with the naval guns it has been decided that the artillery shall be provided with 4·7 guns, together with the necessary limbers and carriages. Vickers, Sons, and Maxim, Limited, have received orders from the Government for forty-two of these weapons. In addition, this firm has on order thirty-five howitzer batteries, together with wagons, limbers, and carriages, and are busy at the moment in making twenty-seven garrison mountings, such as those usually found on the largest battleships, in which will be fixed Vickers' 9·2 guns.

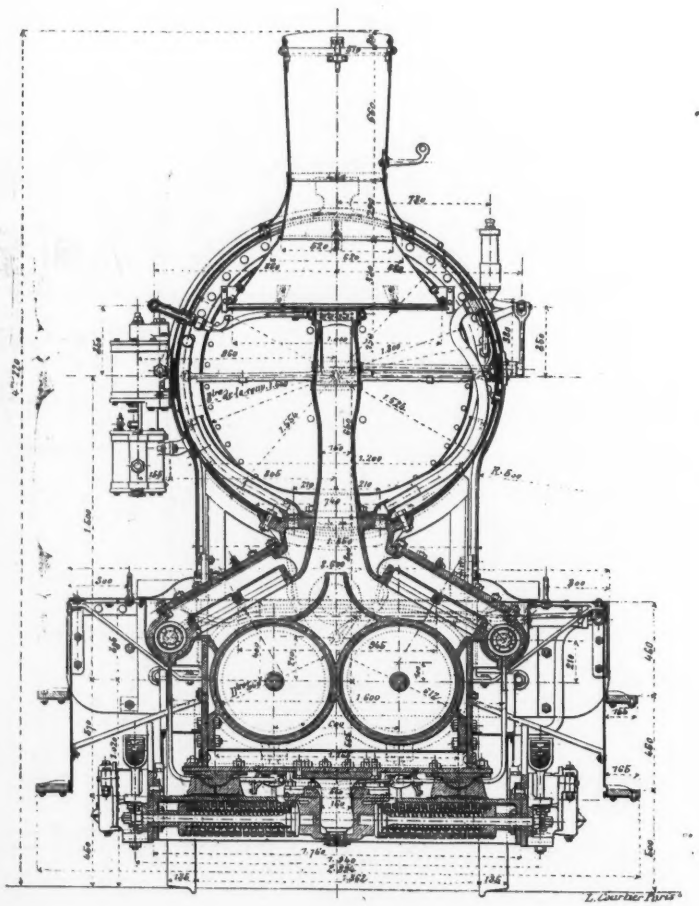
AT a meeting held in Edinburgh on November 28th, the Northern Lighthouse Commissioners appointed Mr. Coventry Dick Peddie, advocate, Edinburgh, secretary to the Board, in room of Mr. James Murdoch, who has retired after fifty-one years' service, during eight of which he was secretary to the Board. The new secretary is the fourth son of the late Mr. J. Dick Peddie—who was an architect in Edinburgh, and for a period M.P. for the Kilmarnock District of Burghs—and received his education at the Edinburgh Academy, Tettes College, and the University. There were no fewer than 250 applicants for the post.

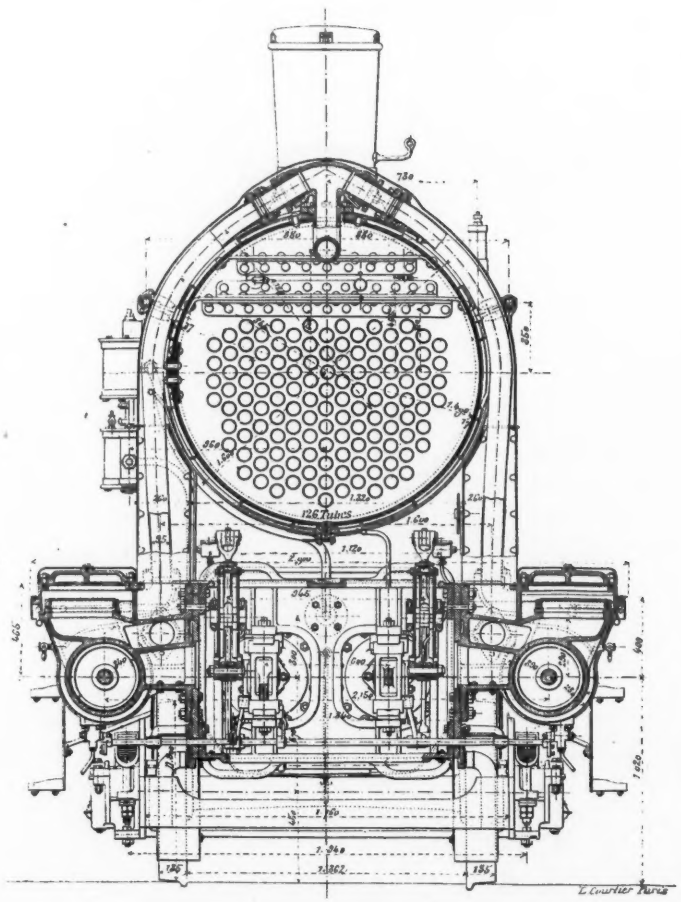
IT is proposed to cut two new canals of considerable importance in Hungary. The Government is at work on the plans. The Danube-Theiss Canal will bring the grain-growing districts of the Alfold into more direct communication with Budapest. According to the preparatory survey, the main branch of the canal will lie between Budapest and Csongrad, and will have a length of 150 kiloms. With the aid of this waterway, the distance by water from the plain of Hungary to Budapest will be very much decreased. The canal will be so designed as to be navigable for the largest Danube barges, and will be destined to supply the country through which it passes with ample water for irrigation purposes.

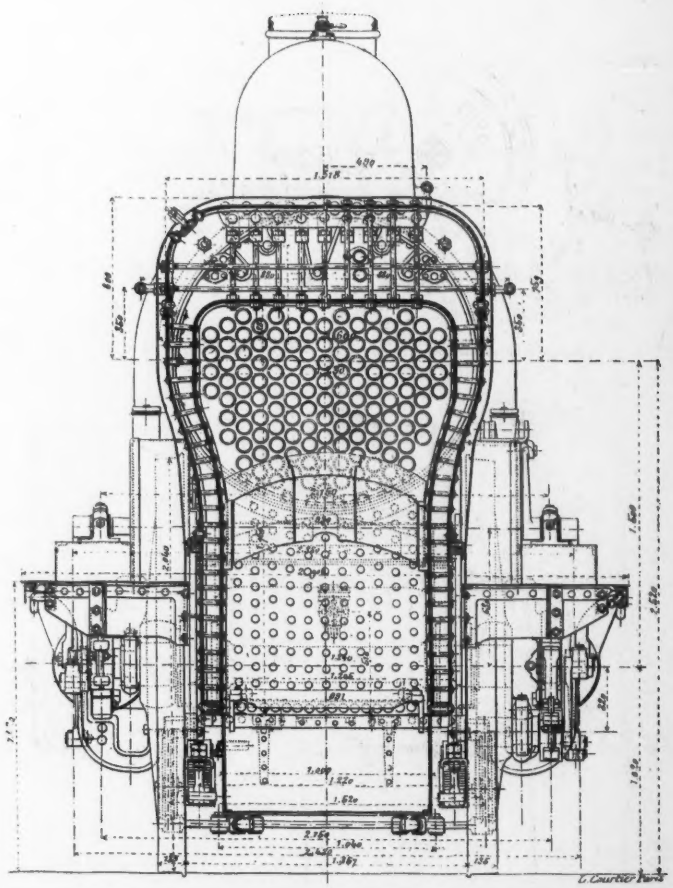
AT a meeting of the East Indian Association held on Tuesday, Mr. W. Sowerby brought forward a project for supplying water in India during times of drought on the partial or complete failure of the monsoon rains. Considerable quantities of water, he thought, could be obtained in almost every part of India by means of deep but inexpensive artesian tube wells. Though the absence of such surveys rendered it difficult to arrive at the exact cost of such works, he calculated that twenty wells, sufficient to supply nearly 150,000 persons and their cattle, could be made for £10,565, including cost of boring apparatus, engine power, buildings, and supervision. Large supplies, again, could be secured by means of accumulating and compensating reservoirs constructed in the valleys of the great rivers, along which there were many low-lying recesses.

FOUR-CYLINDER COMPOUND LOCOMOTIVE, CHEMIN DE FER DU NORD

MM. DU BOSQUET AND DE GLEHN, ENGINEERS







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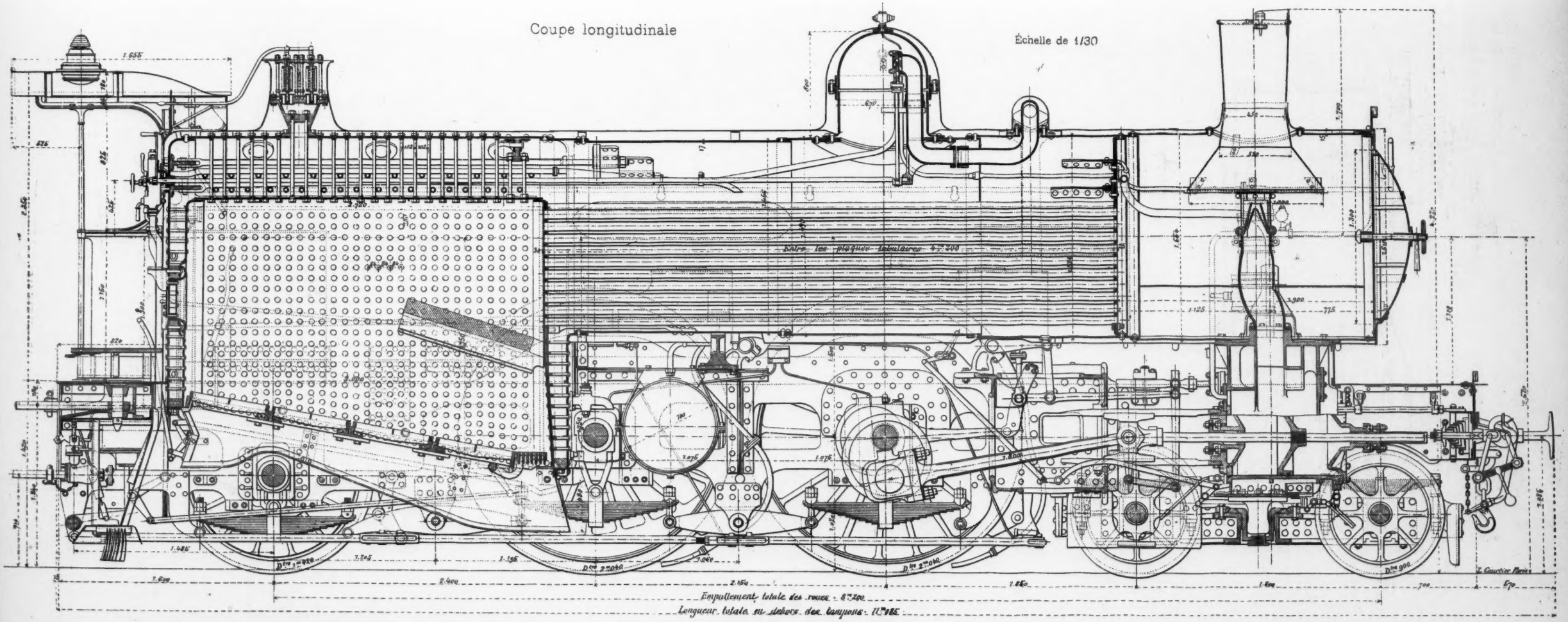

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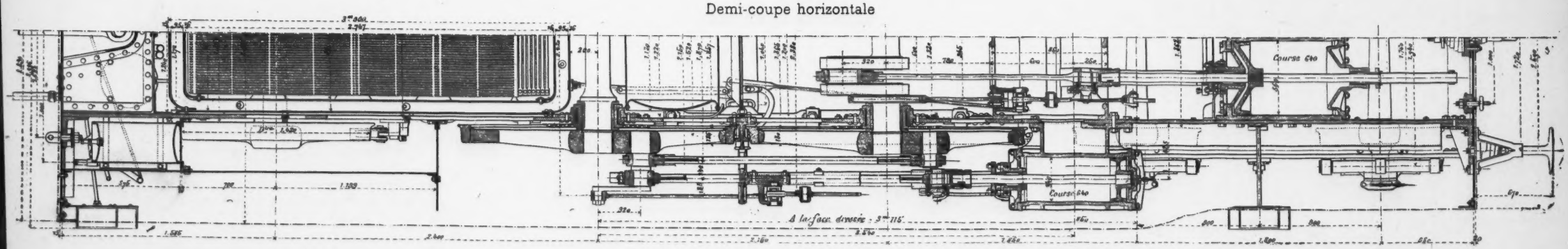

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PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Drawing of a Four-cylinder Compound Locomotive. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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TWO-PAGE SUPPLEMENT—FOUR-CYLINDER COMPOUND LOCOMOTIVE, CHEMIN DE FER DU NORD.

TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.*

REPLIES.

A. J. S.—There is no Board of Trade examination for men in charge of land engines.

STEWARD.—As the earth is spherical, a sheet of water is curved to a radius of roughly 4000 miles.

PATRIA.—We do not think the work will be placed in the United States. That already done in this country is not giving results which encourage the placing of more orders at the other side of the Atlantic.

ACHILLES.—We have not published drawings of this engine. It is possible that Mr. Last, of the South Kensington Patent Museum, may be able to help you. In any case, you would do well to visit the Museum.

T. L. (Plymouth).—If you have secured your patent, or at least provisional protection, you should apply to some firm making railway signals. Unless you can succeed in inducing such a firm to take it up, it will be a waste of time and money to proceed further in the matter.

GLASGOW.—We have no doubt that an excellent opening for engineers will be found in South Africa as soon as matters settle down, and if you have the chance you should get employment now with some firm having a South African connection, with a view to being sent out there in charge of the erection of machinery.

AN AMATEUR.—Very large sums of money were spent some years ago on the construction of the Heillmann electric locomotive, which was tried on one of the French railways, and was a disastrous failure. It was constructed in the way you suggest. Steam can be applied with less loss of energy to driving wheels directly than in any other way for the purposes of locomotion.

R. K. (Little Ilford).—There is nothing to write about the use of steam for melting resin or heating liquids; a double-bottom pan is used, and the steam is admitted into the space between the two pans. For heating water in breweries the steam is generally passed through a coil of pipe in the water. As to surface needed, &c., you cannot do better than read the treatise on "Heat" by Box. You can obtain it for a few shillings from any one selling scientific books.

A. B. S. K.—There are, we fancy, about fifty smoke consumers in the market, each one of which is better than any one of the others. Under these circumstances you can hardly expect us to tell you which is the best. In order to help you, however, we tell our other readers interested in the subject that, if they like to communicate with you and help you to prevent smoke and dry bricks with the waste gases from your boilers, we shall be happy to forward their letters to you.

E. R. (Carnforth).—All your reasoning is conclusive enough until you come to the crown stay bolts. If you will think the matter out further you will see that, no matter what force was brought to bear on the copper plate in the way you suggest, it would not rip off the rivets. It, instead of placing a strip of copper under a driving wheel as suggested, you take a strip, secure it to a bridge stay with the bolt, and then strike the copper with a heavy sledge, the only effect will be to bend the copper. In like manner, in the fire-box the side plate would have been bent up flat against the roof. The point to be proved is that a ½in. copper plate could rip off the bolt heads in the way you suggest.

INQUIRIES.

PURE ZINC.

SIR,—I shall be greatly obliged if any of your readers could tell m of any special purpose, other than German silver or Leclanche rods, for which especially pure zinc—99·90 per cent.—would be valuable.
December 4th. A. E. T.

NIAGARA CALCIUM CARBIDE.

SIR,—Will any reader kindly let me know, through the correspondence column of your paper, the address of the makers of calcium carbide manufactured at Niagara Falls, America, or of the agents for it in England? They had at one time a depôt in Newcastle.
December 3rd. A. B.

MEETINGS NEXT WEEK.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' ASSOCIATION.—Monday, December 10th, at 7.30 p.m. Paper, "Gold Extraction from Free Milling Ore," by Mr. H. H. Johnson.

THE INSTITUTION OF JUNIOR ENGINEERS.—Friday, December 14th, at 8 p.m., at the Westminster Palace Hotel. Paper, "The Metallurgy of Tin," by Mr. J. H. Davy James, Member, of Swindon.

THE INSTITUTION OF MECHANICAL ENGINEERS.—Friday, December 14th, at 8 p.m. Paper, "Power-gas and Large Gas Engines for Central Stations," by Mr. Herbert A. Humphrey, Member, of Northwich.

HULL AND DISTRICT INSTITUTION OF ENGINEERS AND NAVAL ARCHITECTS.—Thursday, December 13th, at 8 p.m., at the Technical School, Park-street. Paper, "Ships' Machinery; Ways and Means of Repairing Deep Sea Cables," by Mr. F. H. Street.

SOCIETY OF ARTS.—Monday, December 10th, at 8 p.m. Third Cantor Lecture on "Electric Oscillations and Electric Waves," by Prof. John A. Fleming, M.A., D.Sc., F.R.S.—Wednesday, December 12th, at 8 p.m. Ordinary Meeting. Paper, "The Treatment of London Sewage," by Prof. Frank Clowes, D.Sc.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, December 11th, at 8 p.m. Papers to be read and discussed, "The Signalling on the Waterloo and City Railway," and "Note on the Signalling of Outlying Siding Connections," by Mr. Alfred Weeks Szlumper, M. Inst. C.E.; "Signalling on the Liverpool Overhead Railway," by Mr. Stephen Butler Cottrell, M. Inst. C.E.—Wednesday, December 12th, at 2.30 p.m. Students' visit to the Engine Works of James Simpson and Company.

DEATH.

On the 1st inst., at Springfield, Edenbridge, CHARLES SELLS, M. Inst. C.E., M. Inst. N.A., late of Lambeth, S.E., in his eightieth year.

THE ENGINEER.

DECEMBER 7, 1900.

SIR I. L. BELL ON UNITED STATES COMPETITION.

AT last the British manufacturer has begun to bestir himself and reply to the pessimistic critics who have during the last year or two, heaped abuse upon his head. Nothing has been too bad to say of those whose skill, industry, and enterprise, have made Great Britain the wonder and envy of the world. Their machinery is bad; their methods antiquated; their enterprise lacking; their skill a thing of the past. It is difficult to read censures of this kind without annoyance. We know that they emanate from men who either have no real knowledge of that about which they write, or who have permitted themselves to be carried away and overpowered by American effusiveness of talk, of hospitality, and of size—there is something very telling in a big works, and our friends across the water are quite aware of that fact. The writers who take it upon them to denounce British methods forget that to the men of this country the world is indebted for the birth of all the manufacturing power that it at this day possesses. This is specially and peculiarly true of the iron and steel trades. It was Cort who, in 1784, invented the process of puddling. Although the blast furnace possibly originated in Germany, it was in England that it was first brought to perfection. It was an Englishman, Abraham Darby, who, in 1735, proved that coal could be used as a substitute for charcoal in the manufacture of iron. It was Neilson, an Englishman, who, in 1828, introduced the hot blast. It was Vaughan who, in 1860, built the high blast furnace and obtained a considerable economy thereby. The huge blast furnace of which the United States ironmaster boasts, was used in this country by Cochrane years before America dreamt of it. The world knows what Bessemer did, backed up by Mushet. Mr. Thomas, who invented with Gilchrist, Riley, and others the basic process, was an Englishman. The regenerative furnace, so often attributed to Siemens, was suggested as far back as 1835 by Mr. Stirling, a Scotch clergyman; and so we might go on adding name after name to the list of Britain's worthies. Is there any reason to suppose that a country which has produced such men cannot supply more when the stress comes? That she cannot has only to be stated to be dismissed as obviously untrue.

The veteran ironmaster, Sir Isaac Lowthian Bell, delivered an address to the Institution of Junior Engineers on the 30th of November. It was an address in every way admirable for its intended object. Learned within limits, instructive, and full of purpose. The most interesting feature in it, we think, is the speaker's clear pronouncement on the subject of United States competition in the iron and steel trade. We have just now called attention to the work done in the past; let us hear what Sir I. Lowthian Bell has to say of the present:—"Some correspondents of our own newspapers, in seeking for the cause of our losing ground in the race, attribute it to our ignorance of the scientific truths upon the operation of which success in our calling is so dependent. Those who say so cannot be aware that at Newcastle-on-Tyne, Leeds, Nottingham, Sheffield, Edinburgh, and Glasgow, are large and well-appointed colleges for teaching the sciences, which for the last five and twenty years have been deemed indispensable in Great Britain for a successful career in metallurgy. Besides this correction may be added the fact that almost every ironworks of any importance possesses a suitable laboratory as a guide for its daily operations, as well as for original research."

It is beyond question that the United States manufacturers have imported steel and iron into this country; the quantity is, of course, wholly insignificant; yet the mere circumstance that it has been imported at all has raised fears which appear to us to be wholly unwarranted. "A transaction of this nature," says Sir I. L. Bell, "does not necessarily imply any superiority in economical production. In America as in England the demand for iron and steel is of a fluctuating character. Impressed by the importunity of the consumer, the manufacturer enlarges his powers, the result being a make exceeding the demand for home consumption. Exportation has to be resorted to as an outlet for the excess, the other alternative being a reduced output, even when an actual loss is incurred. Of course, if America pretends that a profitable trade can be carried on by underselling the works in Great Britain now engaged in supplying British requirements, we must submit to the change. I cannot, however, agree as to the ability of my friends on the opposite side of the Atlantic to sweep us on this side out of existence." Sir I. Lowthian Bell considered briefly what were the conditions which govern the question. He laid particular stress on the cost of carriage to which the ironmaster in the States must submit. He showed that the average haul to the Pittsburgh furnaces of coke and iron ore is not less than 777 miles, and the cost of transport is equivalent to 16s. 6d. per ton of pig iron; and he held that, after all, the American ironmaster possesses no advantage, either natural or created by his own energy and skill, which would enable him to import into this country and sell steel save at a loss.

Sir Isaac Lowthian Bell scarcely touched at all, however, on one important element for consideration. We refer to Protection. That has no doubt aided enormously in the development of the American iron and steel trade. Furthermore, no account is taken of the fact that capital is not infrequently spent in the production of goods which are sold at wholly unremunerative prices, while a profit is ostensibly being made. For let us suppose that a company invests £100,000 in an ironworks, carries on for five years, and at the end of that time is bankrupt. It is clear that, during all those years, something like £20,000 a year had been spent on the production of this metal, which might have been sold to that extent under the true market value. Again, when a high tariff secures a high price in the home market, it is quite possible to sell surplus stock at a low price elsewhere and yet make a considerable profit on the whole year's transactions. It is just because the trader can sell at home for 20 dols. that he can sell abroad for 10 dols., and with this fact we must take account. But, after all, a competition of this kind has very narrow limits, and with due care it is not to be feared.

Much has recently been said about the perfection of the machinery used in American rolling mills, and the resulting diminution in the amount of labour employed. But, in point of fact, the labour necessary in any iron or steel works depends largely on the character of the product turned out; and, curiously enough, the heavier the ingots, plates, or bars made, the smaller in proportion is the manual labour needed. It is, indeed, impossible to handle the larger sizes and heavier weights without machinery; and in all English, Welsh, and Scotch works of the more important character the most improved machinery will be found.

But it must not be forgotten that conditions vary. Circumstances alter cases; and it by no means follows that the mechanical appliances which are best adapted to one country, or even to one district, must be absolutely the best all round. After all the question is one of pounds, shillings, and pence. When wages are high, it may be praiseworthy, or at least necessary, to spend large sums on plant, while a similar expenditure would be wholly imprudent where labour was cheap. In the United States it is very expensive. Here it is not; and although a splendid rolling mill plant for handling ingots, plates, and bars, almost wholly without the aid of manual labour is very attractive, particularly to the uninitiated, it must not be taken for granted that to introduce it into this country would certainly effect remarkable economies.

Be this as it may, we rest well assured that if we are to be beaten in the production of iron and steel by the United States it will not be for lack of skill, energy, or enterprise on the part of our own ironmasters, but solely because the United States will be found to possess natural advantages over which men can exert no sort of control. "It has been reserved," says Sir I. L. Bell, "for one or two editors and special correspondents of British newspapers to impute 'muddle' and incompetency to British ironmasters. With these I daresay I stand in the position of the fabulous English fox disdaining to meet the fabulous tortoise of America, to the latter of which the victory, as in the fable, is awarded by our critics. In the meantime, however, I have left our tons of steel at the works on the respective banks of the Monongehela and the Tees, with the disadvantage to the former of having to carry its ton to New York, a distance of 444 miles, added to a sea voyage of 2500 miles. The possibility of this competition is supported even by some Englishmen, on the ground of the vast superiority of the Bessemer works and rolling mills of Pennsylvania. My reply to this assertion is that the entire wages paid, not a bad criterion of relative expense for producing a ton of steel rails in England, would not suffice to transport the American article to the ship which has to convey it across 2500 miles of the Atlantic and German Oceans."

Whether the United States really do possess natural advantages which will enable them to cope with difficulties of this kind or not is an open question. We believe that they do not. The present state of the trade is wholly abnormal. Over-production has, beyond question, taken place in America. At this side of the Atlantic the contrary is the case, and it is not remarkable that bars and billets should find their way here. If their introduction serves to help the tin-plate trade of Wales out of a difficulty, the importation need not be regarded as a peculiarly lamentable affair.

ELECTRIC LOCOMOTION.

On the 29th of November Mr. W. Langdon, vice-president of the Institution of Electrical Engineers, read before that body a paper of singular excellence, on "The Supersession of the Steam by the Electric Locomotive." As the paper will be found elsewhere in our columns we shall not quote from it here. The excellence of the paper lies in the care with which it has been got up, and the moderation and caution with which the author states his facts and advances his opinions. It differs from many other utterances of the same kind, in that it is evident that Mr. Langdon has fully appreciated the position. It is all in vain to point out the mechanical perfections of traction by electricity. These do not address themselves to directors, or make any recognised claim on the shareholder. The whole question is one of pounds, shillings, and pence. If railway traffic can be worked more cheaply with the electric than it is with the steam locomotive then the former will in process of time supersede the latter. We need not follow Mr. Langdon through his figures; it will be enough to say that he arrives at the conclusion that the electric locomotive will do all that the steam locomotive can do; and that the doing will cost with the first 7·021d. per train mile, and with the latter 8·943d. We are very much of Mr. Mantalini's opinion as regards fractions in such statements. Indeed, we go so far as to say that while we accept without question calculations worked out to one place of decimals, and take two places after inquiry, we treat three places of decimals with incredulity, and regard four places and more as wholly unworthy of consideration. Eliminating fractions, then, we have 9d. for the steam locomotive against 7d. for the electric locomotive—a substantial saving, amounting, in the case of the 50 miles of the Midland Railway from St. Pancras to Bedford, of "£260,000 on the average yearly cost for twenty-four years."

We need not, we think, concern ourselves much with the details of the working arrangements which Mr. Langdon has sketched out. In the main they would, no doubt, be efficient. There is, however, one somewhat important point worth notice, which is, that sufficient provision does not appear to have been made for the presence of more than one train in a ten-mile section on each of four lines of rail at a time. There might, as a matter of fact, be more than double that number of trains. It would be quite possible, indeed, to have as many as a dozen trains all demanding the current at once from a sub-station; but all this refers to details, and we may pass on to the consideration of the main point at issue—the cost of working. In the first place, let us see how much power Mr. Langdon has allowed. He gives it, on the average, as 452 ampères per train, at 540 volts. This represents only 327 indicated horse-power, which is not, we think, nearly enough. Taking the weight of an express train, including the electric locomotive, at 300 tons—and that is not far from the present weight of the Midland expresses—and assuming that the resistance is only 10 lb. a ton at 50 miles an hour, we must have 400 horse-power at the least. A side wind, bad weather, various causes, will easily double this resistance. On the other hand, certain slow trains will require less power, and the goods trains still less. We shall be nearer the mark than Mr. Langdon is, we think, if we take it that the average demand for power per train will be 400 indicated horse-power at least. The question of power is most important. It lies at the root of Mr. Langdon's calculations, and on it rests the whole force of his reasoning. It will be seen that in the main his advocacy of the electric locomotive is based on the economy to be secured by its use, and he has arrived at the opinion that such an economy can be effected on the assumption that the average powers required will be those stated in his Table IV. He admits that the power required to draw an express train will be 477 indicated horse-power, and, so far, we are in agreement with him; but when he gets down to 183 indicated horse-power for a load of 500 tons, at 25 miles an hour, we find it impossible to agree with him. At that speed 7 lb. per ton is the lowest possible, and that is possible only with good stock in admirable order, with axle-boxes carefully looked after. For 500 tons this represents 3500 lb. tractive effort. This gives us 233 horse-power instead of 183. The formula Mr. Langdon has taken for calculating train resistance is $3 + \frac{V^2}{250}$, where V = the speed in miles per hour. There is no reason to believe that the resistance varies as the square of the speed, and we venture to assert without fear of contradiction that the actual power required to work the traffic between Bedford and London, and *vice versâ*, would be at least 25 per cent. more than that assumed by Mr. Langdon. Indeed, he has taken it for granted that the line is level, or if not, that the gradients will compensate each other; but no fact is better known in railway practice than that gradients do not compensate, and this is peculiarly true of fast traffic. But let us take it that the average energy needed is 400 indicated horse-power under the tread of the driving wheels. Considering all the losses to be incurred, this will mean about 700 indicated horse-power at the generating station at the most moderate computation. Take the the most efficient engines and boilers, it will not be safe to reckon on less than 2 lb. of coal per hour per horse, or 1400 lb. per hour for 700 horse-power. Mr. Johnson's express engines will burn about 33 lb. per mile, or for 50 miles, say, 1650 lb. of coal, and we have therefore a saving effected by the electric locomotive of 250 lb. of coal for the 50 miles run. Mr. Langdon has estimated the cost of coal down to a halfpenny; we cannot attempt to follow him with such minuteness. Let us take coal at 10s., or 120d., per ton, or, say, 7s. 3d. for the 50 mile run. This works out at a little over 1·7d. per mile for fuel for the steam engine, and 6s. 5d., or 1·54d. per mile for the electric locomotive. It is clear from these figures that the economy to be effected by the substitution of steam for electricity cannot possibly reach anything like twopence a mile, seeing that the entire cost of fuel as it is is under that sum. It is well to bear in mind the precise words used by Mr. Langdon: "The main gain, however, is to be found in the economy of a stationary as against an itinerant generator, as well as that much coal is consumed by goods and mineral trains when shunted, and by all trains when standing in stations, the whole of which could be saved if worked by electricity."

The only item, however, in his calculations on which any complete reliance can be placed is the consumption of coal. Even if we take the consumption as a whole, at 50 lb. a mile, including all shunting and standing work, the saving to be effected does not, as we have seen, work out to more than a fraction of a penny per mile. Mr. Langdon is quite straightforward. He admits that no allowance has been made for shunting operations. This brings us to a question of considerable importance. One of the greatest difficulties to be overcome in electric working is the provision of shunting arrangements at the various stations and termini, and, above all, in the goods yards. So far as can be seen, such yards as those at Kentish Town, for example, could not possibly be worked without the aid of steam shunting engines. The utter inflexibility of electrical traction has always stood in the way of its adoption save on tramways, where the work is quite simple and straightforward. But putting this on one side, and assuming that all trouble of that kind is got over, we come back to Mr. Langdon's own figures, and we find them inconclusive. There is reason to believe that the electric locomotive can, under certain conditions, haul trains at a less cost than can steam locomotives, but we are not sure that these conditions can always be secured. Is there really, we would ask, any definite evidence that electricity can be generated and distributed at less than one farthing per kilowatt hour? It has been generated, it is stated, but not distributed, at about that price, at one very large installation in the United States, but this coal cost little more than half the price allowed by Mr. Langdon. Can Mr. Langdon cite a case where coal is put on the furnace bars in a Midland town far from a colliery at 7s. 11½d. per ton, the coal being of sufficiently good quality to generate a kilowatt per hour for only 3 lb? We doubt it.

Finally, we may repeat that Mr. Langdon's paper is excellent, and that he has stated his case very fairly indeed. He has probably done as much as can be done by a paper to get the electric locomotive introduced. If, however, he has this thing really at heart, he will not let the matter rest where it is. He will proceed to prove by data obtained on lines where the electric locomotive has been at work for some time that the cost can be kept down to the figures he has given. We doubt that an allowance of about 2½d. per train mile is quite enough for the renewal of machinery, motors, cable, &c. His estimate of the electrical power required is based exclusively on the formulæ for train resistance which we have quoted, instead of on the actual results obtained in practice on electrically-worked tramways. There are no published data as to the amount of power required to work a heavy train by electricity at high speeds. In fact, we are from first to last in the world of assumption; and yet it ought to be quite possible, we imagine, to get a definite statement of the horse-power required to work trains on some of the London or provincial electric-worked lines. Perhaps Mr. Langdon will write a supplemental paper on the subject giving the required information. We may, however, add that, according to our own experience, it has hitherto been next to impossible to obtain any information of the kind at once complete and trustworthy, either because it has not yet been collected, or because the engineers and others do not care to make the facts public. The time has passed, however, when reticence was excusable; and we have no doubt that the Institution of Electrical Engineers can, if so disposed, supply the world with information absolutely necessary to the formation of a right estimate of the value of Mr. Langdon's proposals.

YORKSHIRE COALOWNERS AND THE LOCOMOTIVE CONTRACTS.

ALTHOUGH the South Yorkshire coalowners are backed in their demand for 15s. per ton for next year's railway locomotive contracts by the fact that they have agreed to give the men 10 per cent. advance in January and February next, the altered position of the coal market will go a long way in frustrating their object. It is well known that with the exception of the Midland and a minor company or two, the railway companies paid 16s. per ton for their half-year's supplies. The state of the trade in the last month of the year, even for house coal, is only quiet, and the pits are working short time. The scare in the month of July of a coal famine, with fuel at 50s. per ton before Christmas, has not come about, but it had the effect of causing consumers to lay in such stocks as to place them in such a position that they will have no need to trouble the coal merchant for some time to come. Whatever is the outcome of the pending negotiations, coalowners would do well to take a lesson from the present "fall" in the coke trade, brought about by the high price of coke. So far as can be gathered, the Great Northern has been in receipt of the coalowners' tenders for a week, but the Midland has only been sent on during the last few days. The tenders are under consideration, but no official intimation has yet been received. The Great Northern has, however, made known the fact that it considers 15s. per ton too high a price, as the advance on last year's supplies would even then be at the rate of 4s. per ton. The altered state of the trade and the short time worked will, it is believed, cause the Notts and Derbyshire coalowners to be keen competitors, as the contracts often enable the pits to be kept going when they would otherwise have to stand. In addition to this important consideration is added the fact that the money is always safe, the payments prompt, and the coalowners are, as a rule, regularly supplied with wagons.

ANGLO-GERMAN CABLEGRAMS.

FREQUENT complaints concerning the inadequacy of telegraphic communication between England and Germany have appeared for some time in the German Press, and these complaints seem to be by no means unfounded. For instance, in order to show the slowness with which telegrams are exchanged between the great commercial centres of both countries, it is said that the financiers of Bremen are accustomed to have their telegrams announcing the fluctuations of the Liverpool Exchange sent thence by way of New York, as by this means they obtain the news much quicker than if the messages were sent directly from Liverpool. The business firms of Berlin also make use of the same method, and their London telegrams are despatched thence to New York and thence to Berlin. This roundabout way is of course much dearer, as the cost per word is increased by nearly 2s.; but the great increase in the cost of cablegrams sent between England and Germany by way of New York is amply compensated for by the accelerated service. The simple explanation of this state of matters consists in the fact that Berlin has more connections by cable with New York than it has with London, and for this reason the cable service between England and Germany ought to be increased.

ELECTRICITY ON THE UNDERGROUND RAILWAY.

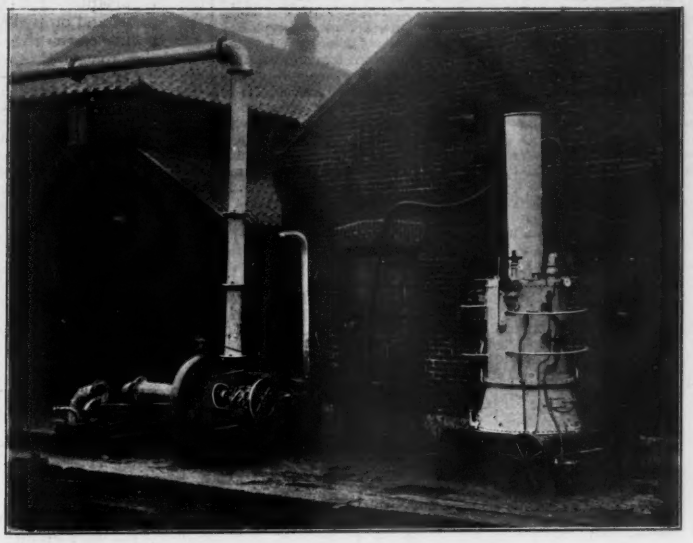
IT seems that there is not a little misconception abroad about this matter. We hear of statements made on both sides of the Atlantic, almost contemporaneously, that tenders for work to the value of £5,000,000 are, or were, to be invited; that fifty miles or so of railway were to be dealt with—and so on, on the same scale. All these statements are gross exaggerations Tenders there are no doubt, but for comparatively limited work, and when they come to be examined they will be found very far short of £5,000,000, probably not a tenth of that sum. What we should like to know is this, Who inspires these extraordinary mis-statements?

ERRATUM.—In a notice of the Chevalet-Boby heater detartariser last week we gave the name of Mr. Robert Boby in mistake for William Boby.

SOCIETY OF ARTS.—The second lecture of the course of Cantor Lectures on "Electric Oscillations and Electric Waves," was given last Tuesday, December 4th, by Prof. J. A. Fleming, F.R.S., at the rooms of the Society of Arts. In this second lecture he dealt especially with the subject of electric resonance. He pointed out, in the first place, that every electric current has a natural period of oscillation depending on its capacity and self-induction. Circuits are also divided into good and bad electric radiators. In the good radiators electric oscillations set up very quickly subside, because they impart their energy to the ether as electric waves. In the bad radiators the oscillations are persistent. If two circuits which are bad radiators have the same natural period of oscillation, then electric oscillations set up in one excite sympathetic oscillations in the other. This was shown experimentally by employing two circuits, in one of which was a small incandescent lamp. The lamp was illuminated by the secondary oscillations when its circuit was at a very great distance from the primary if the two circuits were in tune with each other. Several other experiments were shown illustrating the effects of electric resonance. It was pointed out that the most satisfactory theory of light is that which ascribes it to electrical oscillations set up in the ether, and in this case the familiar optical phenomenon of absorption and colour must really be due to electric resonance. In conclusion, reference was made to the importance of electric resonance in the case of wireless telegraphy, and specimens of duplex or independent wireless messages were exhibited which have been sent and received by Mr. Marconi at the same time by pairs of wireless telegraphic instruments working independently along the same thirty-mile distance between the Isle of Wight and Poole. The lecturer stated that Mr. Marconi, by an extremely ingenious application of the principles of electric resonance, had completely solved the problem of rendering wireless messages independent of each other.

DOVER HARBOUR BOARD, PORTABLE SALVAGE PLANT

MERRYWEATHER AND SONS, LIMITED, GREENWICH, ENGINEERS



PORTABLE SALVAGE PLANT FOR DOVER HARBOUR.

USEFUL as is the present type of salvage plant, its usefulness is greatly curtailed by its want of portability and its general unhandy character. As a rule the plant consists of a cumbrous boiler of the locomotive type, which supplies steam to a pumping engine, or, in some circumstances, steam is taken by the engine from a ship's donkey boiler. Either of these steam raisers weighs some six tons or so, and both are therefore practically fixtures. The reason for using a large boiler is that hitherto it has been considered that salt water feed, which has sometimes to be employed for salvage purposes at sea, is inimical to small boilers, and that heavy boilers with large tubes must be used. That this opinion is no longer tenable is proved by the results of a test of the portable salvage plant which we illustrate above by a perspective view of the complete plant, and by a view showing the boiler with its outer shell removed for inspection. This plant has recently been constructed for the Dover Harbour Board by Merryweather and Sons at their Greenwich works.

The plant consists of a light quick-steaming boiler of the vertical type, in which steam is raised for use in a small but powerful horizontal engine driving a centrifugal pump, the engine and pump being portable as well as the boiler. The chief feature of novelty in the plant is the boiler, which is constructed on the principle of the makers' fire-engine boilers, but is modified in design to enable it to work with salt water. The boiler is about 5ft. high and 3ft. 6in. in diameter, and weighs only about 30 cwt. complete. It is fitted with seventy inclined water tubes, and is worked at from 60 lb. to 80 lb. pressure, as may be necessary, developing from 20 to 30 horse-power. As will be seen from our illustration, it is mounted on a truck with locking fore-carriage to enable it to be easily moved about; it is also provided with slings for handling with tackle. In order to keep down the density of the salt water, the feed is admitted into the boiler at the bottom of the outer space, and a scum-cock is provided near the top of the working level of the water. This scum-cock is always kept open during working, and the water is maintained at any pre-determined density.

As will be seen from the illustration, the boiler is easily opened for inspection and repairs, by breaking the joint round the shell. It can be readily cleaned out in every part and put together again in about an hour. In the event of the failure of a tube it can be taken out and a new one inserted in half an hour or so. Sight-holes are provided in the shell over the crown plate, so that the condition of the boiler can be observed at any time. Wash-out plugs are fitted at the bottom of the water space for ordinary washing out purposes. With natural draught only, the boiler is stated to have evaporated 730 lb. of water per hour with a consumption of under 1 cwt. of coal. This evaporation can be considerably increased by the use of a small steam jet in the funnel. The advantages claimed for the boiler are that it provides power in a form more easily handled for temporary work than the locomotive or the donkey boiler usually employed, as it is only about one-fourth the weight or size, and can be used in many positions where it would be impossible to take a boiler of the usual construction. For instance, although the plant will be kept in a depôt at Dover and run out on the pier for use when required, it can also be shipped on board a tug and steamed out to sea to work, should it be found necessary.

The pumping portion of the plant consists of a high-speed horizontal engine, driving direct an 8in. centrifugal pump, capable of delivering from 1200 to 1500 gallons per minute. It is, like the boiler, mounted on a truck provided with slings for ready handling. The plant is complete with certain accessories, including flexible and other steam pipes, various lengths of 8in. iron and flexible suction and delivery pipe, and a connection for using several lengths of hose as a delivery for fire-extinguishing purposes in the holds of vessels, thus widening the sphere of its usefulness.

The new plant was recently tested at Messrs. Merryweather's works to the satisfaction of Captain Iron, the Dover harbour master. Although brine of the density of sea water was used during the trial, the immunity of the boiler from salting up under steam was fully demonstrated. At the close of the trial the shell of the boiler was removed and the tubes and water space were found to be perfectly free from deposit, as we had the opportunity of observing, although the boiler had been under steam for a total of twenty hours. During the trial a rocking motion was imparted to the boiler in order to test it for priming, which, however did not take place.

THE EMPRESS FOUNDRY, MANCHESTER.

NEW works, laid out on modern lines, have been erected at Cornbrook, in the outskirts of Manchester, by Isaac Storey and Sons, Limited, to meet their increased requirements, and to replace the coppersmith and engineering works established by the firm in 1837, at Knott Mill, in the city. These new works comprise offices, warehouses, foundries, coppersmiths' department, machine, erecting, and brass finishing shops, and we give illustrations of some of the more important sections.

Electrical power is distributed from a central generating station to motors, driving either groups or single machines. As no public supply of electric current is available at Cornbrook, the firm decided to put down a generating plant of their own, to supply the current both for power and the lighting of the whole works. A view—Fig. 1—of the power-house is given on page 574. The chief engine is of the Proell-Corliss type, tandem compound, surface-condensing, of the firm's own make. In this engine use is made of the Proell automatic expansion gear, in connection with a positively-driven Corliss valve, which is used only to distribute the steam and effect the exhaust, the admission and cut-off being both obtained from the expansion gear, which automatically varies the cut-off in accordance with the work that is being done. The low-pressure cylinder has a similar Corliss valve, but in this case there is a fixed cut-off, and no expansion gear. Both cylinders are steam-jacketed by live steam. The engine frame is of the girder pattern, with bored slides, and the main bearings are of the modern type, with wedge adjustments for the brasses. The boiler pressure is 150 lb. per square inch, and the engine speed 125 revolutions per minute.

The engine drives, through ropes and a countershaft placed in the basement under the gallery on which the switchboard is fixed, either or both of two "Castle" dynamos, each capable of an output of 200 ampères at 230 volts, both of which are connected to the driving shaft by Snyer's patent clutches. As there is no supply of circulating water available, the condensing of the steam is accomplished by means of rain water collected from the roofs into a tank, and cooled by one of Mills' patent "lateral current" re-coolers, fixed over the boiler-house. The make-up necessary owing to evaporation is, in dry weather, obtained from the town's mains. The other generators are a smaller set of combined high-speed engine and dynamo and a gas-driven set, both of which can be used for sectional lighting or overtime. The Ship Canal, which is in close proximity to the works, supplies a good deal of all-night work, for which this small gas-driven plant is extremely useful, making it unnecessary to keep up steam and dispensing with the attendance of the engine-room staff. During holiday times, and when steam is not available, it is also employed for lighting the offices and effecting repairs. The switchboard is arranged on the principle of providing main feeders for both the power and lighting current, running to local distributing boards in convenient places in the shops. The main board is in connection with the two larger dynamos, whilst there are two smaller boards for the other dynamos. These are all so connected that the current from any dynamo can be used for power and lighting in any part of the works. In the boiler-house there is a Lancashire boiler, by Thos. Beeley and Son, of Hyde, with a Green's economiser. The feed-water is taken from the hot well, and filtered in a "Sentry" filter, practically the whole of the grease being thus extracted.

The main machine erecting shop, of which we give illustrations, is 120ft. long by 80ft. wide, with a 40ft. clear span in the centre, served by a Vaughan 10-ton electric travelling crane. In addition there are two jib cranes, each capable of handling about 30 cwt., which serve certain of the heavier tools. Round three sides runs a gallery carrying light machine tools, chiefly engaged in brass finishing work. The first of the views—Fig. 2—of this shop shows the central portion, devoted mainly to erecting. Two sets of surface-condensing plants, with air and circulating pumps, are shown, and as they are of a special character a few details will be interesting. They form part of an order for three sets for the Halifax Corporation. The condensers are of 1800 square feet surface, and have mild steel riveted shells with cast iron water boxes, and brass tubes, and tube plates. The air pumps are of Edwards's patent type, two in number, 14in. diameter, and 12in. stroke; the circulating pump is 14in. diameter, and 12in. stroke. The crank shaft is carried on a stout framing, which also carries the slides; the bearings are self-lubricating, and lined with phosphor bronze. The pumps are driven through spur gearing with raw-hide pinion by an electric motor mounted on a stand carried on the same bed-plate as the pump. The whole plant has a very compact appearance, and is of rigid and serviceable construction. In connection with the erection of this and similar work, it may be stated that there is a truly level bed or table arranged, which can be adjusted to various requirements. Stout cast iron rails, with the top surface machined, are truly laid in the concrete of the floor, and bolted down to slots arranged in these are machined tables, the position of which relative to each other can be altered to a considerable extent without affecting the accuracy of the level. A pit is also provided to accommodate fly-wheels for running tests. The second view—Fig. 3—of the shop shows a portion of the machine tools and fitting benches under the gallery, and the third—Fig. 4—represents one side of the gallery, showing the arrangement of lathes for the brass finishing department. All these tools are arranged in groups driven by motors through short line-shafts, the countershafts for the centre lines of lathes being carried on angle irons running the whole length of the gallery, and supported at suitable intervals by light cast iron trestles. To these angle irons special overhanging brackets are attached, fitted with self-oiling swivel bearings carrying the countershafts. Friction clutches are used with all these light tools, and they are found to give less trouble than loose pulleys. These lathes, and, in fact, all the tools in the shop, are grouped in relation to the speed at which they run, and each group has its own motor. The power taken by individual tools is so slight that a further subdivision is inadvisable. As it is, the motors are mostly of small power, ranging from 10 to 3 horse-power. Eighteen months' experience of this electric driving is altogether favourable, and although the generating plant is not in duplicate, stoppages due to any causes connected with the motive power have been almost unknown. The other side of the gallery is occupied by more or less automatic machines used largely for repetition work, and by the quick-running machines for buffing and polishing. Under the gallery illustrated are the works' stores and the testing room. The latter is fitted with various hydraulic pumps arranged for the rapid testing of small valves and cocks, as well as for the proving of large iron stop valves and similar work. A small high-pressure steam boiler is also installed there, available for tests up to 400 lb. per square inch. The construction of the roof of the main shop is of the "saw tooth" type, with north light. In order to get the clear span of 40ft. for the erecting bay, with the maximum height for the crane lift, it was necessary to adopt special means for supporting the roof. To this end the almost vertical side of each section carrying the lights was made into a girder of composite construction, having pitch pine beams let into cast iron socket pieces, the whole being braced by wrought iron tie rods. This arrangement gives the least possible obstruction to the light, whilst it is very strong and not unusually expensive. Hayward's glazing is used throughout this shop. Outside the main buildings are numerous small ones, including pattern-making shop, pattern stores, smithy, gas producer house, fettling shop, stables, &c. The present equipment of machine tools, it may be added, includes a good many of modern type, by some of the best known English and American makers. The vacant spaces are all allotted to other similar tools, and, as opportunity offers, are being gradually filled up.

INSTITUTION OF CIVIL ENGINEERS: GLASGOW ASSOCIATION OF STUDENTS.—The first general meeting of session 1900-01 was held in the Institution rooms, 207, Bath-street, on Monday evening, the 3rd inst. Professor Arch. Barr, D.Sc., M. Inst. C.E., presided, and in a short introductory address, spoke of the rise, during the fast passing century, of the mechanical arts to the ruling control of the world. He treated of the great improvements which engineering had effected and would still more in the future effect for the benefit of mankind, as for instance in the amelioration of the conditions of life in great cities, by the purification of sewage, sanitation, the abatement of smoke, and by the introduction of tramways and other means of rapid transit, thereby spreading the areas of residence. Dr. Barr prophesied that the gas engine would soon displace the steam engine as a prime mover, and that on railways the steam locomotive would ere long be superseded by the electric locomotive. The great question of foreign competition was next touched upon, and Dr. Barr gave it as his opinion that the remedy could only be found by carefully studying the reasons of the success of our competitors and by making good use of the knowledge thus obtained. Thereafter Mr. F. J. Rowan, Assoc. M. Inst. C.E., read a paper entitled "What is a Civil Engineer?" The author pointed out that, in the minds of many, the definition of the term "Civil Engineer," had been narrowed down and made to exclude many engineers who, by the simple and original meaning of the term and by the definition as given in the Charter of the Institution of Civil Engineers, might justly claim to be civil engineers.

ON THE SUPERSESSION OF THE STEAM BY THE ELECTRIC LOCOMOTIVE.*

By W. LANGDON, Vice-president.

PROBABLY one of the most interesting questions associated with the application of electrical energy to railway work is its eventual supersession of the steam locomotive. Electric locomotives of a capacity equal to that of the steam locomotive, doing similar work, and possessing certain marked advantages, are an accomplished fact, and to many it may seem that the days of the steam locomotive are numbered. We must not, however, forget that that which has been done has its *raison d'être*. Its employment has hitherto been generally confined to localities where the effects of steam and smoke would exercise a baneful influence. Because it has been so employed, and its employment has been attended with such marked success, it does not follow, however much it may appear desirable, that in overland lines of railway electricity will in future prove to be the element of power. Railways are commercial undertakings, in which vast sums of money have been embarked, all of which, investors expect, will produce a certain annual return. The supersession of the steam by the electric locomotive thus resolves itself, primarily, into one of profit and loss. If its adoption will enable railways to be worked more economically than is the case under steam, then it will, with its attendant advantages, sooner or later be adopted—if not by the whole, certainly by the greater portion of the railways of this country; but whatever the ulterior advantages may be, unattended by this result, its adoption will remain doubtful.

The first question to be asked is: Are we in a position to consider the subject? Is the data at our disposal such as to admit of a reasonable treatment of it? I think we are. The primary factors are well known. We know how many pounds of steam we can obtain from a given quantity of coal. The efficiencies of prime movers and electrical generators, the loss in transmission, transformation, and distribution are all determinable. Any advantages yet to come must be looked for in the steam generator and in the simplification and consequent ultimate increase of efficiency in the electrical apparatus. In each, no doubt, the future will see production cheapened. Labour may advance, but competition will grow, and in the price of the manufactured article we may reasonably look to the future to produce some advantage.

Having then the material at hand, it is reasonable to conclude that the consideration of the subject can only be attended with good; for, if it should be shown that advantage is to be anticipated from such a change, it will help us to grasp that which has to be attempted, and perhaps to evolve from the data at our disposal the course most desirable to follow.

The railways of the United Kingdom comprised on the 31st of December, 1899,† the following mileage of line:—

Double line or more	11,977
Single line	9,723
Total mileage	21,700

The number of locomotives employed for working these railways was 20,461. The total number of vehicles of all descriptions was rendered as 752,930. The year's cost for locomotive power, including stationary engines, was £16,491,377. The number of miles travelled by trains was 396,241,265. Number of passengers—exclusive of season tickets—1,106,691,991. The tonnage of minerals, 206,611,190; and of general merchandise, 117,011,835.

In dealing with a question of this nature it seems desirable to produce these figures; but they are, in fact, except to afford some idea of the magnitude of the subject, of very little use. The length of the passenger journeys is not stated, nor are the journeys taken by season ticket holders included. To be of value the per passenger mileage, including, of course, the journeys made by season ticket holders, should be given. The same objection applies to the mineral and goods tonnage statement. It records the tonnage declared as placed upon the railway, but whether it is carried one mile or one hundred miles is not shown. In fact, the returns, as rendered, aid the consideration of the subject very little; and I am sorry to say the information in the hands of the railway companies themselves carries us no further.

Under these circumstances, the establishment of a common basis upon which to consider the relative cost presents much difficulty. The only manner in which it can be approached is by averaging the data obtainable, or by examining the work of a particular section of line.

In Table I. I furnish extracts from the Board of Trade return for the year 1899, showing the mileage of line, cost of locomotive power, train mileage worked, &c., for England and Wales, Scotland and Ireland, together with certain deductions therefrom applicable to these results; as also similar data in reference to six of the most important English companies.

In considering the mileage of line quoted, it should be mentioned that the figures do not disclose the *mileage of roads*. Over many sections of the several lines of railway there are more than two roads. Most main routes working out of London possess four, and even six roads, for a considerable distance; and the same applies to other busy portions of the chief railway systems.

The table indicated shows that the cost of locomotive power for the United Kingdom, including stationary engines for pumping and other purposes, works out at 9·988d. per train mile. That the cost for England and Wales is 10·253d.; for Scotland, 8·862d.; and for Ireland, 8·104d. And that this cost varies with the several companies quoted as follows:—London and North-Western, 9·477d.; London and South-Western, 9·844d.; Great Northern, 9·892d.; Great Western, 9·905d.; Midland, 10·218d.; and North-Eastern, 12·266d.—their average cost being 10·267d.

Column *l* indicates the number of trains per mile per hour, based upon the mileage of line of railway shown by the returns. Bearing in mind that there are, over many portions of the railways indicated, several lines, or roads, the number of trains travelling per mile per hour is, perhaps, surprisingly small. Ireland claims but 0·615; Scotland, 1·609; England and Wales, 2·505. Of the railways individualised, the Great Western has an average of but 2; the London and South-Western and the Norrh-Eastern each 2·2; London and North-Western, 2·9; Great Northern, 3·3; and the Midland, 3·7 (that is, the Midland, for instance, has, on an average, 3·7 trains passing over each *mile of line of railway*, each hour; not that the mile of line is occupied by these 3·7 trains during the entire hour, but that that is the average number of trains worked over the mile of line of railway—quite irrespective of the number of lines of rails—within that period of time).

If trains were, in practice, so distributed, this might form a basis on which to found a comparison of cost for the entire railway system; but we know that this is not so—that trains are much more frequent on certain portions and less frequent on other portions of the lines of railway, and although it is a kind of basis, affording some very interesting figures, it is not, as it stands, a practical one for the purpose in view. To effect this it is necessary to consider the work of an individual section of some line of railway; and with this view I have taken that portion of the Midland Company's main line between London (St Pancras) and Bedford—omitting the suburban and local traffic applicable to the Metropolitan and Tottenham lines.

The length of line of railway is 49·5 miles—practically 50 miles; and the number of lines of rails applicable to the traffic under consideration may be taken as four—it is not less. In order to ascertain the number and character of trains to be taken into consideration, I have obtained returns (Tables II. and III.) extracted from the Block Book of those trains passing two points—Luton and Harpenden—each hour, during a day of twenty-four hours in the month of July, 1900, which I have summarised and classified so as to bring the subject within reasonable scope. These details are carried forward to Table IV., which forms the basis of calculation for comparison of cost for power to work the traffic indicated.

The classification adopted is necessarily somewhat arbitrary, but in its construction I have endeavoured to err on the right side; for instance, I have debited each train of its class as a loaded train, whereas some would certainly be light trains. Again, I have, I believe, accorded to each their full merit of speed, although there is reason to assume that in many instances certain goods and minerals would not observe that allotted to them. From this table we get the tractive effort per train, and the consequent mechanical and electrical power required to deal with one hour's work. The work may, and of course does, vary from one hour to another; indeed, that is clearly shown by Tables II. and III.; for instance, the trains passing Harpenden vary per hour from 7 to 16, and Luton from 7 to 19, but the section of line chosen may be regarded as a full line, a line well occupied by trains both night and day, Sundays and week days. The returns show an average of 11·9 trains passing Luton, and of 12·4 passing Harpenden, per hour. In taking an average, however, I have apportioned no less than 14 trains to the hour. This number divided between the four lines of metals gives a result of 3·5 trains per mile per hour per line of metals. It may here, however, be as well to point out that, so long as the appropriated number of trains is fairly that in practice, the number applied is, for comparison purposes, immaterial, for the comparison I draw is based upon the train mileage cost.

(To be continued.)

* Institution of Electrical Engineers, read November 29th, 1900.

† Board of Trade Railway Returns, 1899.

TABLE I.—*Mileage of Line, Cost of Locomotive Power, Train Mileage, &c., for Year Ending December 31st, 1899.*

(a)	Length of line in miles open on 31st December, 1899. Double or more.	Single.	Total. (b)	Cost of locomotive power including stationary engines. (c)	Number of locomotives. (d)	Number of miles travelled by trains. By passenger trains. (e)	By goods and minerals. (f)	Total. (g)	(h) Cost per train-mile for locomotive power. $\frac{c}{g}$	(k) Number of miles travelled by trains per hour during year of 365 days. $\frac{g}{8760}$	(l) Number of trains per mile per hour (365 days to the year). $\frac{k}{b}$
				£					Pence.		
England and Wales	9,933	5111	15,044	14,101,842	17,411	178,684,803	151,377,926	330,062,769	10·253	37,678	2·505
Scotland	1,423	2057	3,480	1,811,552	2,241	27,588,633	21,473,089	49,061,722	8·862	5,601	1·609
Ireland	621	2555	3,176	577,983	809	10,367,617	6,749,157	17,116,774	8·104	1,954	0·615
Total—United Kingdom	11,977	9723	21,700	16,401,377	20,461	216,641,053	179,600,212	396,241,265	9·988 Average	45,233	2·084 Average
RAILWAY COMPANY.											
Great Northern	—	—	825	995,690	1,259	11,729,522	12,426,497	24,156,019	9·892	2,757	3·3
Great Western	—	—	2,602	1,884,032	1,933	28,085,087	22,561,470	45,647,157	9·905	5,210	2·0
London and North-Western	—	—	1,924	1,927,049	2,959	26,285,278	22,515,697	48,800,975	9·477	5,570	2·9
London and South-Western	—	—	900	709,110	728	12,598,300	4,689,644	17,288,034	9·844	1,973	2·2
Midland	—	—	1,431	2,016,816	2,507	18,979,594	28,387,090	47,366,684	10·218	5,407	3·7
North-Eastern	—	—	1,632	1,632,967	2,047	14,641,572	17,307,802	31,949,374	12·266	3,647	2·2
									Average 10·267		

TABLE II.—*Luton. Statement of the Number of Trains Recorded in the Block Book for the Twenty-four Hours ending Midnight on Thursday, July 19th, 1900.*

Hours.	Express passenger.	Ordinary passenger.	Coaches.	Fish and milk.	Express goods. Class "A."	Express goods. Class "B."	Ordinary goods.	Minerals.	Light engines.	Total number of trains each hour.
12 to 1 a.m.	2	—	—	—	1	5	—	3	—	11
1 to 2 a.m.	—	—	1	—	—	10	—	2	—	13
2 to 3 a.m.	—	—	1	3	1	3	—	5	—	13
3 to 4 a.m.	1	—	—	—	—	3	—	6	—	10
4 to 5 a.m.	1	—	—	—	3	5	—	6	—	15
5 to 6 a.m.	2	—	—	—	2	4	1	2	—	11
6 to 7 a.m.	1	1	—	—	3	—	1	5	—	11
7 to 8 a.m.	1	1	4	—	2	4	1	3	—	16
8 to 9 a.m.	1	1	—	—	1	2	—	2	—	7
9 to 10 a.m.	1	—	—	—	—	2	—	4	—	10
10 to 11 a.m.	4	1	—	—	—	1	1	4	—	11
11 to 12 (noon)	3	—	—	—	1	1	1	3	—	9
12 to 1 p.m.	4	1	—	—	—	1	2	5	—	13
1 to 2 p.m.	4	1	1	—	—	2	—	4	—	12
2 to 3 p.m.	6	2	3	—	—	—	—	8	—	19
3 to 4 p.m.	2	3	—	—	1	—	3	5	—	14
4 to 5 p.m.	4	—	1	—	—	1	5	5	—	11
5 to 6 p.m.	4	2	—	—	—	—	2	3	—	11
6 to 7 p.m.	5	1	—	—	—	—	—	4	—	10
7 to 8 p.m.	4	2	1	—	—	—	—	5	—	12
8 to 9 p.m.	—	2	1	—	3	—	—	1	—	7
9 to 10 p.m.	2	—	—	—	1	2	—	4	—	9
10 to 11 p.m.	5	2	—	—	—	2	2	7	—	16
11 to 12 (midnight)	2	1	2	—	1	6	3	1	—	16

Classification.

Express passenger	62	
Ordinary passenger	21	86
Coaches	15	
Fish and milk	3	
Express goods—Class "A"	20	74
Express goods—Class "B"	51	
Ordinary goods	18	115
Minerals	97	
Total number of trains during the twenty-four hours	287	
Maximum number of trains in one hour	16	
Minimum number of trains in one hour	7	

TABLE III.—*Harpenden. Statement of the Number of Trains Recorded in the Block Book for the Twenty-four Hours ending Midnight on Thursday, July 19th, 1900.*

Hours.	Express passenger.	Ordinary passenger.	Coaches.	Fish and milk.	Express goods. Class "A."	Express goods. Class "B."	Ordinary goods.	Minerals.	Light engines.	Total number of trains each hour.
12 to 1 a.m.	2	—	—	—	3	3	1	4	—	13
1 to 2 a.m.	—	—	1	—	—	9	2	2	—	14
2 to 3 a.m.	—	—	1	3	1	3	1	1	—	11
3 to 4 a.m.	—	—	—	—	3	3	1	3	—	11
4 to 5 a.m.	1	—	—	—	5	4	1	1	—	13
5 to 6 a.m.	3	1	—	—	4	2	1	1	1	14
6 to 7 a.m.	—	—	—	—	2	5	1	1	1	9
7 to 8 a.m.	2	3	2	—	2	5	—	—	1	15
8 to 9 a.m.	4	1	—	—	1	—	5	3	—	14
9 to 10 a.m.	5	2	—	—	—	1	3	1	—	12
10 to 11 a.m.	3	1	—	—	1	1	—	1	—	7
11 to 12 (noon)	5	—	—	—	2	2	2	2	—	11
12 to 1 p.m.	5	2	1	—	—	1	2	2	—	12
1 to 2 p.m.	3	2	—	—	—	1	6	3	1	16
2 to 3 p.m.	5	3	1	—	—	1	3	2	1	16
3 to 4 p.m.	4	1	1	—	—	1	2	3	1	13
4 to 5 p.m.	3	5	—	—	—	—	2	2	—	12
5 to 6 p.m.	5	1	—	—	—	—	2	2	—	10
6 to 7 p.m.	3	1	—	—	—	—	2	2	1	9
7 to 8 p.m.	6	2	—	—	2	—	1	—	—	11
8 to 9 p.m.	2	3	—	—	1	2	1	3	1	13
9 to 10 p.m.	3	2	—	—	—	3	3	3	1	15
10 to 11 p.m.	3	2	—	1	1	1	1	2	1	12
11 to 12 (midnight)	—	1	1	—	4	4	2	2	—	14

Classification.

Express passenger	67	
Ordinary passenger	33	41
Coaches	8	
Fish and milk	4	
Express goods—Class "A"	22	78
Express goods—Class "B"	52	
Ordinary goods	55	
Minerals	46	111
Light engines	10	
Total number of trains during the twenty-four hours	297	
Maximum number of trains in one hour	16	
Minimum number of trains in one hour	7	

TABLE IV.—*Basis of Calculation, Showing Number of Trains, Classified, Passing Certain Points of a 50-Mile Section of Line of Railway; Calculated Mechanical Horse-power and Electrical Power for Working the same, together with Apportioned Speed, Load, &c.*

Class of train.	Number of trains per day of 24 hours passing. Luton.	Harpenden.	Basis of Calculation. Apportioned number of trains per hour.	Speed, miles per hour.	Train-miles per hour.	Load, including engine.	Total tractive effort per train.*	Mechanical H.P. per train-hour.	Equivalent in K.W. hours.	Total. Mechanical H.P. per hour.	Equivalent in K.W. per hour.
						Tons.					
1. Express passenger	62	67	3	50	150	275	3575	477	356	1431	1068
2. Ordinary passenger and empty coaches	36	41	2	32	64	300	2130	182	136	364	272
3. Express goods and perishables	74	78	4	35	140	400	3160	295	220	1180	880
4. Ordinary goods and minerals	115	111	5	25	125	500	2750	183	137	915	685
Totals	287	297	14	—	479	—	—	—	—	3890	2905
Average per hour	11·9	12·4	—	—	—	—	—	—	—	—	—

Tractive effort per ton $= 3 + \frac{V^2}{250}$ where V = speed in miles per hour.

$$H.P. = \frac{\text{Tractive effort pounds} \times \text{miles per hour}}{375}.$$

* Tractive effort × load tons = Total tractive effort per train.

THE SOCIETY OF ENGINEERS.—Amongst other guests who have accepted the invitation to the annual dinner of the Society of Engineers on Wednesday, December 12th, are Lord Rosmead, Admiral Sir John C. Dalrymple Hay, chairman of Council of the Royal United Service Institution; Colonel H. Barron R.A.; Major Lowe, R.A.; Sir William H. Preece, past president of the Institution of Civil Engineers; Sir Wm. Chandler Roberts-Austen, president of the Iron and Steel Institute; Professor John Perry, president of the Institution of Electrical Engineers; and Mr. Alexander Siemens.

LETTERS TO THE EDITOR.

(We do not hold ourselves responsible for the opinions of our correspondents.)

VENTILATION AND HEATING.

SIR,—This correspondence seems to be concerned chiefly with the relative merits of fans *versus* furnaces for moving air in buildings. Mining engineers forty years ago usually ventilated their mines by means of a furnace placed at the bottom of the upcast shaft, although they had the fuel "on the spot," and only burned the commonest and cheapest kind. They invariably now use large and expensive fans and engines, being so much more efficient, and what is true in the case of a mine will be true in the case of a building. Mr. Ingham appears to be championing the furnace. He says fans create draught. We might ask the question, What is a draught? or what is the velocity of air that constitutes a draught? No two persons will give the same answer. He says that with a furnace he can get a velocity of 400ft. per minute entering the room. Well, I know people who say that would be a draught, and I also know that some of our largest ventilating engineers make the ducts such a size that the velocity through them is considerably less than 400ft., and they use fans. The question of draughts in a room does not depend upon whether a fan or a furnace is used, but upon the area of the ducts. There is no reason why air should not move at 50ft. per minute, excepting the enormous size the ducts would require to be.

The advocates of the furnace system claim that by passing the fresh air through hot tubes all the bacilli are killed. This advantage is not of much importance—except in the operating theatre in an infirmary—as all of us are condemned every day to go outside amongst the fresh air which requires purifying, and it would not be convenient to carry portable air heating and cleansing apparatus about.

Some of the school boards specify that in winter the air in every class room must be changed ten times per hour and in summer fourteen times. How could that be complied with on the furnace system? Why, even in Langfield's catalogue, which Mr. Ingham kindly procured for me, they recommend a fan for summer ventilation. In winter in a dwelling-house you can get very good results with a furnace, but in summer you have got to open the windows. I think most of us will be agreed that in large buildings, such as hospitals, colleges, schools, &c., where it is necessary to have good ventilation, in summer it is advisable to use fans. Most of our large buildings are heated by hot water or steam, and the reason why these agents have so far superseded fire heaters is not far to seek.

In the case of the fire heater the rooms nearest the heater get warmer air than the rooms at the extremities of the building; if you shut off some of the air going into the near room, then, of course, the ventilation suffers. Again, there is a great waste of heat carrying hot air long distances in underground ducts.

If we use hot water or steam we are much better off; heating elements can be placed at the bottom of every vertical duct, or as is more usually done, one battery is placed so as to warm the air for two or three rooms; there is a sliding door and a bye-pass in connection with each battery. These doors are connected by wires or chains to some portion of the building where the caretaker or attendant can regulate the amount of air which goes through the battery, or along the bye-pass and into the rooms; thus the temperature can be controlled without altering the ventilation.

Crouch End, December 1st. J. A. M'LAREN.

NAVAL ENGINEERS.

SIR,—I have read your articles on the subject of naval engineers, and, noting your expression of disappointment at your first scheme not having received the criticism you anticipated, may remark that I have waited until your alternative suggestion had been presented before entering into any discussion.

I would first like to express my regret at the acrimonious note that has been struck by some of your correspondents on this subject, and which, as far as I can see, has nothing whatever to do with the settlement of the important question of the position a naval engineer should hold. I refer to the spirit of recrimination as between naval and mercantile marine engineers. As a naval engineer, I feel assured that were the mercantile marine engineer trained sufficiently on board a man-of-war, he would be quite as capable of fulfilling the duties of that position as a naval engineer; but those duties differ in many respects by the nature of things, and, speaking generally, I regard each in his own sphere as equally able and competent; but I also feel sure that were the mercantile engineer placed in the position of the naval engineer on board, he would at once realise the many difficulties under which the latter has to perform his onerous duties, and we should hear from him very soon the same tale told of insufficient authority in his department that has so often been brought to the public notice during the past twenty-five years. It may, however, be worth noting that the functions of a man-of-war are more than simply steaming from port to port, as was pointed out in THE ENGINEER early in 1899, and that in our fast liners there is always an ample allowance of boiler power to maintain the required speed, and no risks of failure are run by insufficiency of either engineers or firemen, nor of ample repairs at the end of every voyage. Moreover, the chief engineers of those ships, it is pleasant to reflect, are practically their own masters, and kings in their own departments, which is very different from the condition that prevails in the Royal Navy.

Now, Sir, to come to the discussion of your proposals. I would first touch upon your alternative scheme, which appeared in your last week's issue, and remark that it is one that must meet with the approval of all thinking men, and one that may in the very far future be realised; but with existing prejudices and class privileges so very much in evidence as they are at present, I regard it as of too Utopian a nature to come within the range of now-a-day practical politics, alas! and so must fain leave it with a most favourable recommendation to the consideration of posterity.

But to hark back to the first scheme which you propounded, viz., that the engine-room work should be done by highly-paid, very competent men, with warrant rank, under the control of an executive engineer officer, highly trained, and corresponding to an officer of the Royal Engineers. Two points relating to this highly-trained officer, to make the scheme workable, present themselves. These are his "training" and "the supply."

Now it may be taken for granted that no one, however highly trained he might be on shore, which is the training you would appear to suggest, would be competent to take charge of a marine engine of any description without a certain amount of experience with marine engines at sea under working conditions. Were he to be embarked and placed directly in charge of the machinery of a battleship without any sea-going experience, he would be placed immediately in the hands of his subordinates, warrant officers, and would as a natural consequence have to be taught by them until he became conversant with all the ramifications of his ship, and the complicated nature of man-of-war life. It is but natural to suppose that his subordinates would take advantage of this, and his position would be not only unenviable but practically impossible, his authority would not be that of the centurion of old for a considerable period, whilst a blow would have been struck at the very root of naval discipline. Assuming it to be granted, then, that this highly-trained officer must receive some training afloat, it very nearly brings us back again to the present position of affairs, as there would have to be at least two junior commissioned officers, besides the senior, qualifying themselves for the position of chief engineer. I say two, because I am convinced that the process of training to be efficient would have to be conducted through two stages; and here I may say that I regard the present Admiralty training of the naval engineers—except in a few minor details, and that it is too short by one year—as one of the very best systems in this country, and any training for the higher position which you have suggested would have to approximate to the one now in vogue.

Now as to the question of supply. If there is only to be one engineer officer on board, apart from the question of training, how is the supply to be kept up? There are at present about 400 naval engineer officers, out of a total of 1000, who are in charge of machinery, and I take it that these 400 engineers would be in time replaced by the highly-trained executive officer of your proposed scheme. At present it takes 600—roughly—junior engineers to keep up the supply of chief engineers. Unless these juniors were embarked for training and duty afloat, how would they be disposed of? Would they be kept eating their heads off in a training college till required? I venture to think a generous public even might kick at this expense; and it is pretty evident that a naval life would not attract anything like a sufficient number of "ready-mades" from civil life. It would seem that we are here brought back to our former conclusion, that for efficient training and economical reasons, and to keep up the supply, we must have more than one highly-trained officer on board. There are other reasons. The Admiralty system is to centralise all responsibility in the chief engineer. In war time, over-fatigue would in consequence shortly incapacitate him, and at any time sickness might do so. It is an acknowledged fact that for properly handling and leading men in our naval and military services commissioned officers are necessary—and therefore it is necessary to have more than one of this rank available. Again, by only having one engineer officer, the chief engineer, for this he would be, however trained and styled, would be deprived of his right-hand man and confidential assistant, for no warrant officer, by the very constitution of our naval service, could hold the same position as regards consultation and confidence that can exist between commissioned officers even of different grades, and the interests of the service would suffer considerably in consequence. May I humbly suggest that there can be very few better judges of what is required to put the naval engineers on a satisfactory footing than the naval engineers themselves, and what they feel will settle this vexed question for good and all is to give them executive rank in their own department, that is to say, real rank, and the authority which real rank carries, with suitable titles to mark that rank—and this is practically what your scheme, Sir, amounts to when boiled down slightly. Let us have the very competent highly-paid warrant officers by all means, if they are to be obtained, but these will never obviate the necessity of having as well executive naval engineer officers, who need not necessarily be actuated by the sole desire to conduct the admiral's daughter through the intricacies of the mazy waltz, as so amicably suggested by your correspondent "Mercantile Chief."

December 4th. CHIEF ENGINEER, R.N.

SIR,—One reason why there is so much grumbling among naval engineers is that we have so little to do. The life in port, unless you can make some pleasant acquaintances on shore, is horribly monotonous. The engines cannot keep you employed all day; you are often at your wits' end to find work for the stokers and artificers. The want of useful employment promotes brooding. The engine-rooms of her Majesty's ships are never so happy as during the manœuvres, when work is the order of the day and the night. WEARY ONE.

Chatham, December 3rd.

GAS FROM SLUDGE.

SIR,—I have read with considerable interest the letter in your last issue from Mr. Naylor, who seems to be conversant with the experiments being conducted under Mr. Alderman Hibbert, the chairman of the Sewage Committee at Chorley.

One can only heartily wish every success to the praiseworthy efforts being made to utilise sewage for the purpose of obtaining illuminating gas from it, as well as the almost as important consideration, the complete destruction of the sludge itself.

Your correspondent appears to know what the average gas engineer, immediately the facts are presented to him, argues concerning the matter. While not professing to hold a brief on behalf of those in charge of gas undertakings, I think I may safely disclaim any such stupidity and ignorance as are unwarrantably implied by the statement referred to.

Gas engineers have a great many interests to consider before contemplating the wholesale utilisation of sewage sludge for gas manufacture. One of the most important of these is the large quantity of moisture present in the sludge, amounting to 30 or 40 per cent.

It is out of all question to attempt to carbonise material containing such a large quantity of moisture in costly retort settings designed especially for the carbonisation of coal. A lower temperature is required for the distillation of gas from sewage sludge than for coal. This is only one of the numerous items requiring adjustment and consideration.

I am fully in accord with Mr. Naylor as to the probability of all the difficulties presenting themselves being overcome. At the present time the practical utilisation of the material is receiving a large amount of attention.

With reference to obtaining a yield of 7000ft., per ton of sludge, the average of several tests, the lowest being 6000 and the highest 9000, this can only be regarded as eminently satisfactory to all interested in the subject.

Considering the important issues involved in the success of the movement under consideration, one ventures to hope that any gentlemen who have been experimenting in this direction will place the information obtained at the public disposal, through the medium of your columns.

I am continually receiving items of information conveyed to me by letter or other means, all of which go to prove that a large amount of work has already been accomplished in a quiet way. Possibly the comparative apathy of gas engineers is due to the subject being one directly for the sanitary authority rather than for them.

Gasworks, Huddersfield, 26th November. EDWARD A. HARMAN, Engineer and Manager.

THE EFFICIENCY OF FANS.

SIR,—From the letter of "P. W.," in your issue of November 30th, I see that it is necessary for me to again state most emphatically that a vacuum does exist in the throat—*i.e.*, in the small end—of a diverging pipe, and that it is at this point where the density of the air is least.

I not only stated this in my last letter, but gave abundant evidence of its truth, but it now appears that "P. W." considers the vacuum to be "an apparent loss of pressure due to an inductive action." To refute this absurdity, I need only point out that the "inductive action" would require to be of a highly capricious nature to produce the phenomenon of a suction in the case of a diverging pipe, and the very opposite effect—viz., a pressure—in a parallel one.

If the theories set forth by "P. W." be really the "usual normal explanation," as he states—though I can only accept the statement to a limited extent—then it seems very necessary to dissipate these fallacies, and to this end I suggest that "P. W." try the two following simple experiments with water, and I am prepared to lend him a small diverging pipe, and also a parallel one of the same diameter as the throat of the former.

First experiment: Measure the outflow per minute from the diverging pipe with any head of water up to about 12ft., then drill a hole through the side of the pipe at its small end, and again measure the outflow, whereupon it will be found to be considerably less, probably to the extent of 70 or 80 per cent. if the side hole be of fair-size, such as half the diameter of the pipe. This result is due merely to the air entering through the side hole, and thus destroying the vacuum, either wholly or partially, according to the area of the hole. Second experiment: Measure the respective outflows through the parallel and the diverging pipes when they are fed with the same head of water, which must not exceed about 12ft. In round numbers the latter pipe will deliver double the quantity of water per minute as compared with the parallel one. Now increase the head of water to, say, 50ft., and the diverging pipe will deliver only about 30 per cent. more water, as compared with the foregoing 100 per cent. increase. Care should be taken to have the supply pipe of very ample area in order that the frictional resistance in the 50ft. length shall be slight, and thus not affect the results materially.

The explanation of the above facts is quite a simple one, viz., with about 12ft. head the flow produces a full vacuum, hence at that head the very utmost limit of assistance from the atmospheric pressure has been obtained, and the 50ft. head can obtain no more, thus the percentage of assistance becomes less and less as the head or pressure is increased; consequently, the diverging pipe is far less effective with high pressures than in the case of pressures up to about 6 lb. per square inch. If "P. W.'s" theory were correct, the increase would be the same with all pressures.

Brooke-road, Stoke Newington N., December 3rd. W. A. GRANGER.

THE TARGET BOOK.

SIR,—I have read with great interest the review of the new "Naval Target Book," produced by the Naval Intelligence Department, in your issue of November 30th. The extraordinary inaccuracy that seems to have been exhibited in the preparation of a very important work fills one with alarm and dread lest all our literature of a similar nature is as useless and incorrect as this book. In time of naval war, it is obviously of the first importance to be able to recognise readily a ship which may turn out to be an enemy, and having recognised her, to have exact information regarding her armour, guns, speed, &c.; but if the information and means of recognition are not to be trusted, it is quite possible, and even likely, that the result would end in disaster. Moreover, there can be no excuse for the publication of a book bristling with errors of the nature you have pointed out, as every year an annual, entitled "All the World's Fighting Ships," is published, which is absolutely up to date, and free from the gross inaccuracies pointed out in your review, and is adopted in many navies as a standard work to be depended upon. Surely if the Naval Intelligence Department are not capable of doing a little pirating, as you suggest, it would be better for them to adopt the book, which is trustworthy, rather than to serve out incorrect and out-of-date information. HANDY MAN.

December 3rd.

PATENTS IN PRETORIA.

SIR,—We have received from Mr. Juta, the acting Registrar of Patents and Trade Marks at Pretoria, a Government notice, a copy of which we give here below.

This notice sets forth the conditions under which applications for patents and trade marks can now be filed in the Transvaal, and in view of the commencement of business in that country, may be of considerable interest to English manufacturers and merchants having trading relations there. EDWARD EVANS AND CO., Chartered Patent Agents.

27, Chancery-lane, London, W.C., November 30th.

GOVERNMENT NOTICE No. 123, OF 1900.

APPLICATIONS FOR PATENTS.

Pretoria, 22nd October, 1900.

By virtue of the authority committed to me, I hereby give notice that from and after this date, applications for patents can be registered with Mr. C. W. Thalman B. Juta, in the Government Buildings, until such time as the Patent-office shall be opened.

Registration as above, if documents are in order, will grant protection, but the statutory time of protection will only begin to run from the date of the re-opening of the Patent-office.

Applicants are cautioned that they must see that all formalities, except as modified herein, of the Patent Law No. 10 of 1898, are complied with, and papers will not be returned to applicants by the Registrar in order to correct mistakes.

The applications for the present may be in English or Dutch, and legalisation will not be necessary until re-opening of the Patent-office.

The order of registration will be the order of priority.

Applications for trade marks may also be registered under similar conditions with Mr. Juta. J. G. MAXWELL, Military Governor.

WATER SUPPLY.

SIR,—The increasing attention being given by waterworks engineers to the subject of waste prevention, as evidenced by the discussion which has taken place in your columns during the past five months, is, I think, in most cases coincident where the demand approaches the limits of a naturally cheap supply. The end in view is that the engineer shall have control of the output, if I may so call it, and two means are advocated for this result:—

(1) The metering of all supplies, and this entails a "positive" meter on such as are domestic.

(2) An efficient and positive system of waste prevention, viz., a good class of fittings, and a district well sub-divided and controlled with waste meters.

Of these two means, I do not think that there can be any doubt as to the latter being the cheaper, both to the water authority and to the consumer. A paper on this subject by Mr. Collins—"Minutes of Proceedings," Inst. C.E., vol. cxvii., page 147—answers many points raised by your correspondent. DELTA.

November 29th.

AN OLD WATERWAY.

SIR,—I am much interested in the account you publish in this week's issue of your paper of the Devizes lock on the Kennet and Avon Canal. The description reminds me of an old canal which ran from Bridgwater to Burlescombe, on the borders of Devonshire, but which for some years has only been open as far as Taunton. I can remember as a boy that on the portion of the canal west of Taunton the barges were in some cases lifted, instead of locked, up steep ascents, and I should be glad to know if any drawings of the old-fashioned lifts then in use are still extant. The portion of this canal now open is the property of the Great Western Railway Company, but as far as I know there is very little traffic upon it. TYETH D. BOUNSALL.

December 1st.

WAGON COUPLINGS.

SIR,—In reference to the letter in your issue of the 23rd inst., re "Wagon Couplings," I must say that the advantages claimed for the hook coupling are, in my opinion, simplicity and strength. It will be very hard to get something better suited than the well tested if somewhat primitive hook and chain to take severe pulls and shocks. I quite agree with your correspondent in your issue of the 2nd inst., when he mentions the existing number of draw-hooks to which our railway and private wagon owners commit their traffic with every confidence. My contention is to give mainly our attention to the shunters in preventing them from passing between the wagons, and an alteration in the present mode of fixing the hook and chain coupling would no doubt be the means of preventing many accidents. SAFETY.

November 28th.

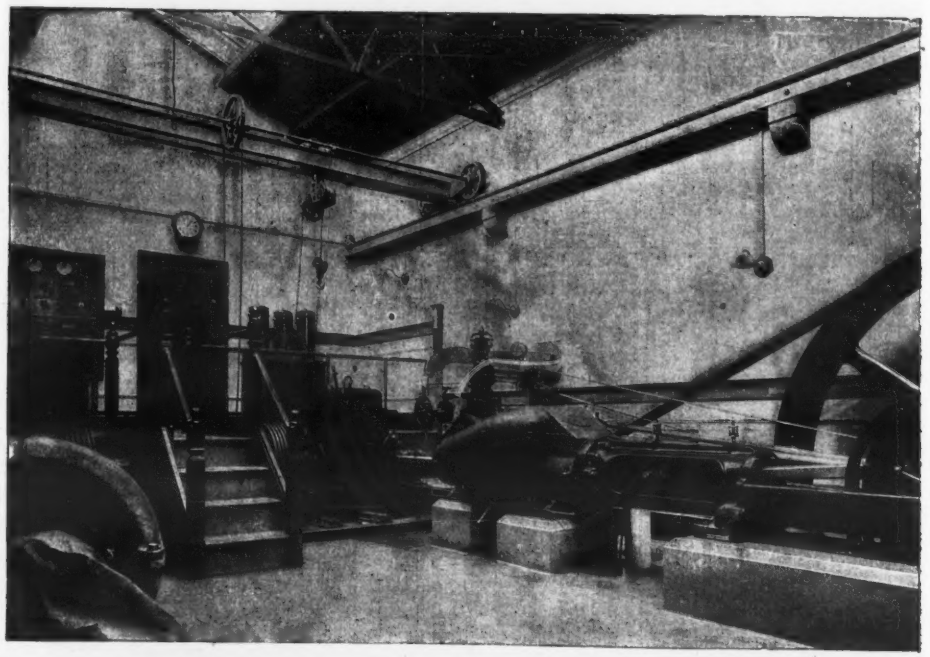
THE ATLANTIC CITY FLYERS.

SIR,—Will Mr. Norman Macdonald or Mr. Stretton tell us what is the consumption of coal per mile of the Atlantic city flyers? I do not want a guess or an estimate, but the real thing. I am told that it is over 100 lb. a mile, but I have no certainty that this is right.

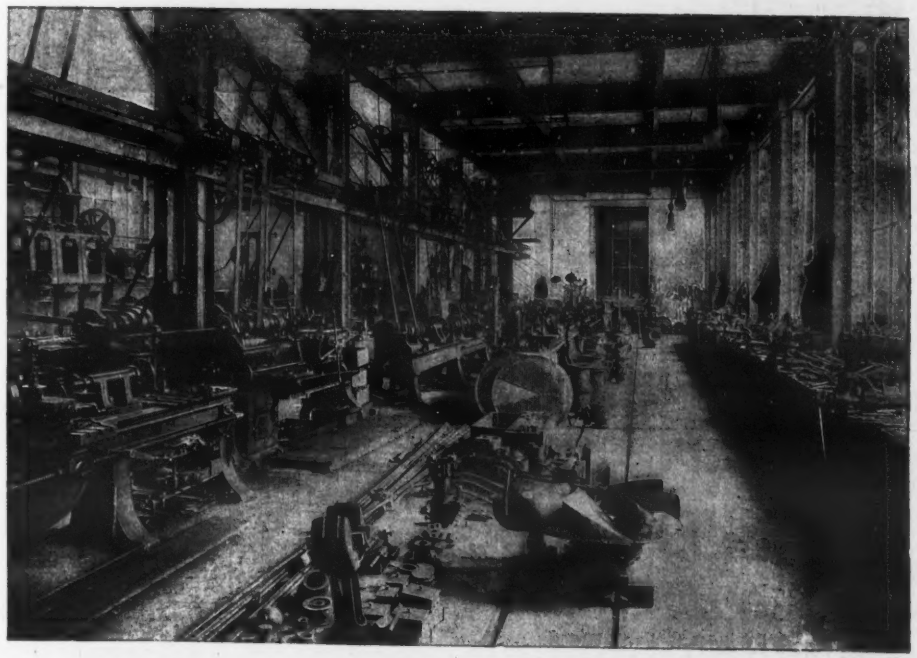
December 3rd. CREWE.

EMPRESS FOUNDRY, MANCHESTER

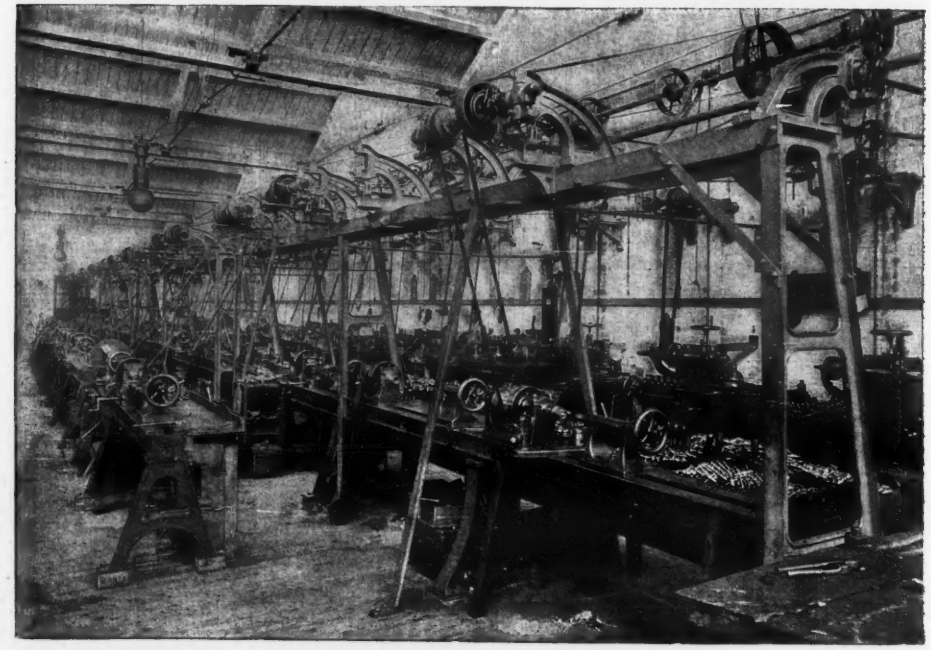
(*For description see page 571*)



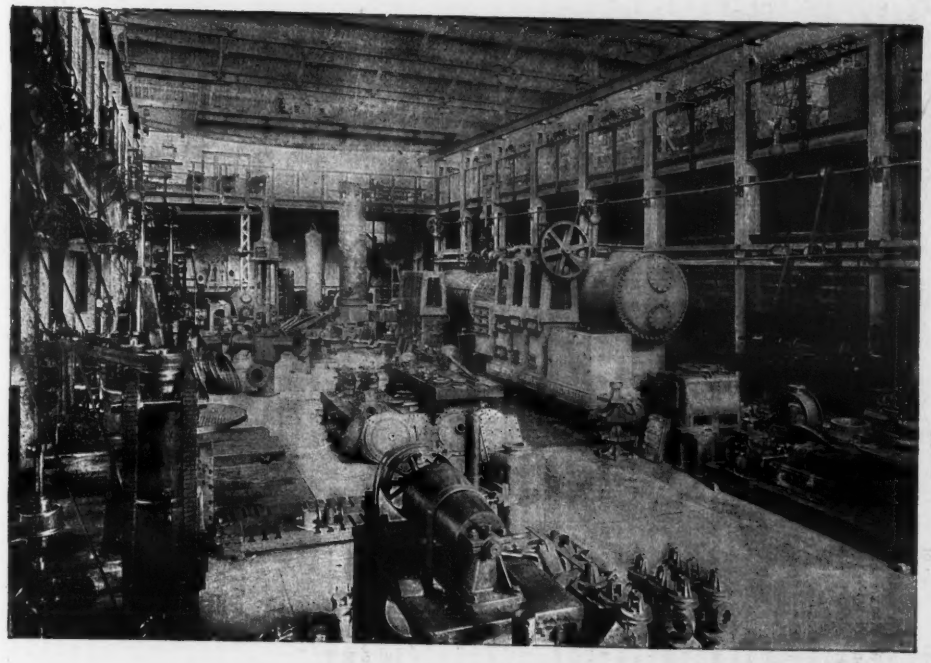
POWER HOUSE



MACHINE SHOP UNDER GALLERY



BRASS FINISHING SECTION IN GALLERY



MACHINE AND ERECTING SHOP

VICTORIAN RAILWAYS.

IN the absence of the Commissioner in England, the Deputy-Commissioner—Mr. W. Fitzpatrick—has issued the report of the working of the Victorian railways for the past year. A better financial result is shown on the year's working than any since 1889; the balance, after paying working expenses and interest on loans, shows a deficiency of only £192,587, equal to a shortage of 0·49 per cent. on the capital cost. This is a gratifying result for the Colony, when it is recollected that only four years ago the deficiency stood at £493,949. The better return has been brought about by the inducements offered for increased traffic bringing up the gross revenue considerably, and not by holding back necessary renewals. Coaching traffic has increased by £98,022, live stock by £9579, and general goods by £43,944, compared with the previous year; the net increase in gross earnings being £151,433, while the increased expenditure amounted to £90,859.

While it is the primary object of the management of a Government railway to make a financial success of the undertaking, it is deemed politic on the part of the State, in order to encourage settlement, or to further agricultural or manufacturing interests, to afford extended facilities or to construct lines which, while they do not add to the net railway revenue, are indirectly of great benefit to the State. This has now to some extent been recognised by the Victorian Government by the passing of an Act providing that, where losses result from carrying out the policy of Parliament or of the Government, the railway department is to be recouped for such loss. This would be a good system, as not affecting a Commissioner's management by experimental legislation, provided it was known what was the actual loss on any class of traffic.

To meet the above case, the railway department has been credited during the past year with £39,000 for the carriage of grain at reduced rates.

During the year concessions to the staff have been granted involving an additional expenditure of £41,000. Extensive renewals have been made to permanent way, which, with ordinary maintenance, amounted to £498,460—an increase of £17,668. Increased cost of coal, increased repairs and renewals of carriages and wagons, and cost of running 393,251 additional miles, have brought the locomotive charges up £46,556 more than last year.

A four years' retrospect on the working of the department accompanies the Deputy-Commissioner's report. A general summary of the transactions for the year ended 30th June, 1900, together with a comparison for the previous year, is given below.

	1900.	1899.
Total spent in construction, including lines not yet opened, and surveys of projected lines	£39,658,819	£39,056,451
Average cost per mile open	£12,278	£12,404
Net interest on railway loans, including expenses on interest payments, redemption expenses, &c.	£1,436,413	£1,472,000
Total miles open for traffic	3,218	3,143
Average miles open for the year	3,186	3,122
Gross revenue	£3,025,162	£2,873,729
Working expenses	£1,807,301	£1,716,441
Net earnings	£1,217,861	£1,157,288
Percentage of working expenses to revenue per cent.	59·74	59·73
Net earnings, after paying working expenses and interest deficit	£192,587	£294,802
Revenue, per average mile open	£950	£920
Expenditure " "	£567	£550
Net return " "	£383	£370
Gross receipts, per train mile	5s. 11·83d.	5s. 11·00d.
Working expenses "	3s. 6·91d.	3s. 6·41d.
Net earnings "	2s. 4·92d.	2s. 4·59d.
Net revenue on total loan moneys expended per cent.	3·32	3·21
Passenger journeys No.	49,382,899	45,805,043
Goods tonnage tons	2,791,650	2,594,752
Live stock "	206,653	184,996
Train mileage	10,107,549	9,714,298
Amount paid during year for pensions and gratuities, not included in working expenses	£95,239	£81,284

LIQUID FUEL.*

By Mr. EDWIN L. ORDE.

THE early history of liquid fuel has been so ably put before this Institution by the late Mr. B. G. Nichol, and later in the admirable paper of Mr. Wallis, that there is no need to-day to recapitulate what has been done up to the present time with this form of combustible. The writer, however, ventures to think that the practical results of some experiments with which he was entrusted, and the conclusions to which they have led, may not be without interest to the members of this Institution, and may at all events form the basis of a profitable and interesting discussion. It is only within the last few years that liquid fuel has come within the province of engineers in this country, owing to the fact that hitherto it has only been practically obtainable in the vicinity of the Caspian Sea at such a price that renders it commercially possible. Within the last few years, however, a considerable change has taken place. New oil fields have been discovered, and the number of places along the Eastern route at which liquid fuel can be obtained has increased so enormously that it has become a serious question for shipowners to consider whether it is not an absolute economy to use it in preference to coal on vessels trading to the eastward. The solution of this question lies first in the cost of the fuel and its practical calorific value as compared with coal; secondly, in its effect on the life of the boiler furnaces in which it is burnt; and thirdly, perhaps the most important of all, its immunity from danger. The first point is, of course, constantly varying, and is one which the writer is not in a position to pursue. The two latter practically resolve themselves into one—the efficient combustion of the fuel. The existing appliances designed for the purpose may be broadly divided into three.

(1) Those in which the liquid fuel is injected into the furnace in the form of a spray by purely mechanical means. (2) Those in which the spray is produced by the introduction of a gaseous medium. (3) Where the liquid fuel is introduced into the furnace in the form of vapour. Before considering the respective merits of these three classes of apparatus, it will be advantageous to realise the actual possibilities of the fuel. The experiments which the writer carried out were made with crude Borneo oil, which is in all respects an excellent fuel oil, and is to be obtained in large quantities. Its composition is:—Carbon, 87·9 per cent.; hydrogen, 10·78 per cent.; oxygen, 1·24 per cent. The flash point is 211 deg. Fah., the boiling point is 395 deg. Fah. The calorific value determined by the bomb calorimeter is 18,831 B.T.U. It is an exceptionally clean and mobile fuel oil, and with its high flash point the risk of adventitious explosion is reduced to a minimum. All fuel oils are exceedingly complex, inasmuch as they are made up of a number of combinations of carbon and hydrogen which only a chemist who has devoted himself to investigating hydrocarbons can appreciate at their true significance. The importance of this point for the practical purposes of the engineer lies in the fact that the various constituents of the fuel give off vapour at temperatures varying from about 100 deg. Fah., up to the boiling point of the oil, and when the boiling point is approached—unless special precautions are taken—a residue of solid carbon is formed which will soon choke any pipes or narrow passages through which the fuel may have to pass. Having thus considered the characteristics of a typical fuel oil, we may now return to the consideration of the apparatus for burning it.

In the first type, the purely mechanical spray, the oil is discharged under pressure into what is commonly called a burner, which is made of such a form that the effluent jet is broken up into particles sufficiently small to burn readily at the firing point of the fuel. The full efficiency of the system can only be obtained by lining the furnace with fire-bricks, or other non-conducting material, so as to raise the furnace temperature—by preventing the absorption of heat into the boiler—until it is sufficiently high to vaporise the greater portion of the oil before it is burned. The quantity of air required to complete combustion is very largely in excess of what is chemically necessary, and the furnace space required for oxidation is large. The advantages of the system are: first, its simplicity; and secondly, its noiselessness. As regards efficiency, the best results that the writer has been able to find recorded show an evaporative efficiency of about 12·5 lb. of water from and at 212 deg. per lb. of oil. With Borneo oil this gives a fuel efficiency of 64·6 per cent.

In the second class the oil is introduced into the furnace in the form of a spray in the presence of a gaseous medium—be it steam or air. In most of these appliances a partial lining of fire-brick is fitted in the furnace, and a brick bridge or baffles of various forms are built with a view of obtaining complete oxidation of the fuel. The earliest form of this apparatus consisted simply of two pipes lying one above the other, and having their ends flattened so as to spread the streams of oil and steam. Oil is admitted to the upper pipe, and is allowed to drop from the orifice into the jet of steam which passes through the lower pipe, and meeting the oil, breaks it up into particles sufficiently small to ignite as soon as the firing point is reached. This simple device has been improved upon by numbers of engineers, and most of the improved burners of this type take the form of concentric tubes, through which the oil and steam are passed. Adjusting arrangements are always provided, so that the supply of the two elements can be regulated at will. This type is better known than any other, and has, so far, given the best results. The evaporative efficiency of the best burners of this type seems to be about 13-14 lb. from and at 212 deg., but the supply of air required for oxidation, though smaller than that demanded by the first class of burner, is much above what is chemically necessary. The difference between steam and air as spraying media will be touched upon hereafter. The third class of apparatus, that is in which the fuel oil is wholly or partially vaporised, promises to give the best results.

Attempts have been made so long ago as 1867 to produce an apparatus on the system, and Colonel Foote claimed remarkable results for his method of solving the problem; these results, however, seem not to be well authenticated. Later, Messrs. Dorsett and Biyth attempted to boil the fuel in one boiler and burn the resultant vapour in the furnace of another. This, however, does not seem to have been very successful. Mr. Thwaite has since then made an apparatus consisting of a retort which is maintained at a red heat, and into the retort a spray of steam and oil is blown; the oil is immediately volatilised, and passes through holes in the retort into the furnace, where it is met by a stream of air in which the vapour burns with a clear blue flame. The results are said to be satisfactory, but it is difficult to see how such a process can be carried out with ordinary fuel oils without producing a large deposit of carbon in some form in the retort.

An experiment tried by the writer with an apparatus on this principle showed that it was possible to produce a high furnace temperature and a smokeless fire, but the retort was soon completely choked with solid carbon, or, if the temperature was allowed to fall, with a pitch-like substance. This deposit presents the greatest difficulty in the way of completely vaporising so complex a body as the ordinary fuel oil. As has been pointed out before, the oil consists of a number of hydrocarbon combinations, each of which has a different boiling point. Another important characteristic of these hydrocarbon compounds is that in the presence of superheated steam they can be completely distilled without cracking, and the explanation of this fact—on which depends the Ragosine process for refining petroleum—has been stated to be that in the presence of superheated steam, the boiling point, or more correctly, the mean boiling point, of the oil is lowered. This distillation, however, does not apparently take place with any other medium but steam.

To ensure distillation it is necessary that the temperature of the oil should be raised to as near the boiling point as possible before it is admitted into the presence of the steam, and it is in this part of the process that the danger of cracking appears. In the apparatus fitted by the firm with which the writer is connected the difficulty has been overcome, and so far as it has been possible to ascertain by ordinary means, complete vaporisation has been secured. The vapour thus produced can be completely oxidised by the amount of air chemically necessary, and a larger quantity of oil can therefore be treated in the same furnace space than by either of the two other systems, while the combustion as shown by the analysis of the waste gases is complete.

Two typical analyses are given below:—

Analysis of waste gases.		Analysis of waste gases.	
Carbon dioxide	= 13·2 per cent.	Carbon dioxide	= 12·6 per cent.
Oxygen	= 3·6 "	Oxygen	= 4·0 "
Carbon monoxide	= 0·0 "	Carbon monoxide	= 0·0 "
Hydrocarbon gases	= 0·0 "	Olefines, &c.	= 0·0 "
Hydrogen	= 0·0 "	Hydrogen	= 0·0 "
Nitrogen	= 83·2 "	Nitrogen	= 83·4 "
	100·0 "		100·0 "

The only feature calling for remark is the somewhat large percentage of uncombined oxygen, which is no doubt due to leakage around the smoke-box. As regards efficiency, an evaporation of from 15 lb. to 16 lb. from and at 212 deg. should always be obtained with dry Borneo oil. The hydrocarbon vapour is exceedingly unstable, and appears to depend for its existence entirely on temperature. Efforts have been made to collect samples for analysis, but without success. In appearance it is of almost milky whiteness, closely resembling the vapour given off from the retort used in the Pintsch gas system. The smell is pungent, and severe irritation is set up in the membranes of the mouth and throat if the vapour is inhaled.

At the temperature of the external air (60 deg.) it was found almost impossible to ignite it, and the outer surface of the jet was at once condensed and formed an oil deposit of a very much lighter colour than the fuel oil itself. The flame when the vapour is burned in a boiler furnace over a layer of broken fire-brick is of dazzling whiteness, and becomes almost transparent as it approaches the bridge. The exact form in which the combustion of these hydrocarbon vapours takes place does not seem to be clearly understood. The appearance of the flame at a distance of a few inches from the nozzle of the burner suggests that at that point the hydrocarbons are burning in the form of acetylene.

All gaseous hydrocarbons, when exposed to a temperature of 1000 deg. Fah., become acetylene, and it seems fair to assume that the vapour will do the same. As the flame proceeds further into the furnace, however, and the temperature becomes higher, the hydrocarbon combination must break up, and the rest of the vapour is probably burned as carbon monoxide and hydrogen. This theory is put forward with diffidence in the hope that the reaction which takes place may be more worthily dealt with in discussion. There seems to be no doubt that the efficiency of liquid fuel lies in the fact that it is capable of being turned into vapours of high calorific power, and that the vaporising process does not demand a large heat expenditure.

The two classes of apparatus first described do not vaporise the fuel before combustion begins, which means that of the heat generated in the furnace some considerable part is absorbed for this purpose, and is therefore not available for evaporating water. To attain to the temperatures required for complete vaporisation, part, at all events, of the constituents must be exposed to the heat of the furnace, but with careful design the quantity of heat thus abstracted can be reduced considerably below that which is necessary to carry out the process when the fuel is simply injected into the furnace as spray. The fact that superheated steam lowers the boiling point of hydrocarbon oils, and therefore prevents cracking, renders its employment essential if it is desired to burn the fuel as vapour. The objection to using it on board ship is, of course, the loss of fresh water and the amount of heat lost in making this loss good by distilling sea-water; this loss, however, is—the writer ventures to think—more than compensated by the gain in efficiency due to using steam as a distilling agent. Mr. Morison has published some calculations of the quantity of fuel required for distilling purposes and applying these calculations to a steamer with engines indicating 2000 horse-power at sea, the quantity of oil fuel required to make up in the evaporator the water lost in the burners only amounts to one-quarter of a ton per day of twenty-four hours. In this calculation Mr. Morison's calculated result has been multiplied by four to allow for deposit on the surface of the evaporating coils.

With air as a spraying agent, there is, of course, no loss of fresh water, but it is questionable whether the quantity of steam used in the air compressors is not greater than that required in the burners and evaporators together. The complete combustion of petroleum spray depends, first, on the correct relation between the volumes of the oil and the spraying agent; and, secondly, on the velocity of the spraying agent, both of which requirements place air at a considerable disadvantage as compared with the steam. The general conclusions deduced from the investigations the writer has made are as follows:—(1) Liquid fuel of good quality, such, for instance, as Borneo oil, used in boiler furnaces if efficiently treated, should show a reduction in consumption of about 40 per cent. as compared with coal. (2) A reduction in bunker space of about 15 per cent. for the same weight of fuel; a reduction of about 50 per cent. for the same radius of action. (3) A reduction in the stokehold staff of at least 50 per cent.

The advantages of liquid fuel as regards ease of manipulation, cleanliness, absence of smoke, reduced temperature of stokehold as compared with coal, increased life of boilers owing to constant temperature, improved performance of engines owing to constant steam pressure, need not be enlarged upon to the members of this Institution, but the question of immunity from danger requires some consideration. With a fuel oil of which the flash point is 200 deg. Fah. or over, there should be no risk of explosion whatever, and unless there is want of ordinary care in the management of the burning apparatus and the fuel supply, the danger of fire ought not to exist. Still, fires have occurred, and it may be well to consider the causes from which they have originated.

The most fruitful cause appears to be intermittent action of the burning apparatus. This may arise from dirt in the oil or from the presence of water. To get rid of the dirt it is only necessary to provide an efficient filtering apparatus, and this should form a part of all liquid-fuel installations. The second cause, the presence of water, presents a more difficult problem. All crude oils have a certain proportion of water intimately mixed with them, and as the specific gravity of most fuel oils is from ·9 to ·98, and in the case of some shale oils even higher, it is obviously exceedingly difficult to eliminate this water by gravitation unless the temperature of the mixture is comparatively high. The expansion of oil under increase of temperature is considerably greater than that of water, and some arrangement whereby heat can be applied to the contents of the bunker seems to be necessary where crude oil is used.

In furnaces where the oil fuel is burned in the form of vapour the danger of extinction from the fact that water is present is of course considerably reduced, for any temperature that is sufficiently high to vaporise a fuel is more than sufficiently high to evaporate water, so that when water passes into the apparatus with the oil it flashes into steam, and though it breaks up the stream of hydrocarbon vapour does not prevent each fraction from burning unless the amount of water is abnormally large.

An experiment made by the writer showed that the fire was not extinguished when water was present in the proportion of five parts of water to three of oil. The water in this case was added gradually and the contents of the bunker were constantly stirred so as to secure as complete an admixture of the oil and water as possible.

With a burning apparatus of the second type where the oil fuel is introduced in the form of spray, the danger of extinguishing the fire when water is present is, of course, much greater, but with a well-designed installation and proper care on the part of the attendants such accidents as fires should be impossible.

The writer hopes that he has to some extent succeeded in laying before the Institution a brief review of the characteristics of liquid fuel and the various kinds of apparatus used for burning it. The subject is one with which there are many members in this Institution better qualified to deal than is the present writer; these gentlemen will, he hopes, contribute some of their valuable experiences with liquid fuel, which will serve to make good to some extent the imperfections of the paper.

* North-East Coast Institution of Engineers and Shipbuilders.

WORKMEN'S COMPENSATION CASES.

November 14th.—Court of Appeal.—Plaintiff, Ferguson; defendant, Green. This was an appeal from a decision of the Judge of the County-court of Lancashire, held at Oldham. The applicant for compensation was a working plasterer. The employers were master plasterers who had entered into a contract with a building owner to do the plasterers' work to some cottages. The cottages had been constructed by means of a substantial scaffolding on the outside, and they had been completely roofed, and the scaffolding had been removed. At the time of the accident, the applicant was engaged on the work of plastering the internal walls and ceilings of one of the cottages, and in order to reach the ceiling and the higher parts of the walls of the room in which he was working he had constructed a platform by means of two trestles across which he had placed some loose boards. He had set on the boards a table, on which he manipulated the plaster, and he stood on the boards to do his work. Finding that the table was unsteady he used a hammer for the purpose of mending it, and while he was doing so a nail flew into his eye and he suffered severe injury. The arbitrator appointed by the County-court Judge declined to make an award in favour of the applicant on the ground that the work was not being carried on by means of a scaffolding within the meaning of the Act; but he fixed an amount of compensation to be awarded in case his decision should be held to be wrong, and he submitted the question whether he was right or wrong in law for the consideration of the County-court Judge. The County-court Judge reversed the decision of the arbitrator, being of opinion that the arbitrator had misdirected himself, and that the question whether the arrangement of trestles and boards used by the applicant was a scaffolding within the meaning of the Act was not a mere question of fact, as the arbitrator had thought, but was a mixed question of law and fact, and that the only answer that could be given to that question, after the judgment of the Court of Appeal in "Maude *v.* Brock," was that it was a scaffolding within the meaning of the Act. The employers appealed, and the Court allowed the appeal.

The MASTER of the ROLLS said that in this case the arbitrator had found as a fact that the arrangement of trestles and boards on which the workman was standing when he met with the accident was not a scaffolding within the meaning of Section 7, Sub-section 1, of the Workmen's Compensation Act, and he had on that ground given his decision in favour of the masters. The County-court

Judge had reversed that, and had given his decision in favour of the workman. This Court had consistently refused to give any definition in law of the word "scaffolding" as used in this Act. They had said that that question was a question of fact, and all questions of fact that arose under this Act were to be decided by the arbitrator in each case, this Court only sitting to hear appeals on questions of law. They had said that in one of the earliest cases under the Act. Then came three cases—"Wood *v.* Walsh," "Hoddinott *v.* Newton, Chambers and Co.," and "Maude *v.* Brook"—in each of which they refused to meddle with the finding of fact of the tribunal below as to whether that which was alleged to be a scaffolding was a scaffolding or not. In "Maude *v.* Brook" the facts were not distinguishable in substance from the facts of this case. An arrangement of trestles and boards was used for the purpose of plastering the walls and ceilings of a building, and the County-court Judge found as a fact that that arrangement was a scaffolding. Lord Justice Rigby and he—the Master of the Rolls—held that there was evidence on which the County-court Judge could find that it was a scaffolding, and they refused to interfere. Lord Justice Collins came to the conclusion that the trestles and boards afforded no evidence of a scaffolding within the meaning of the Act. In his opinion the County-court Judge could not properly overrule the arbitrator's finding on a question of fact if there was any evidence to support it. He therefore thought that the award of the arbritrator must stand, although the result was that there had been two different findings on exactly similar facts.

LORD JUSTICE COLLINS said he was of the same opinion. It was now clearly decided to be the law that an arrangement such as that used in this case might be a scaffolding. Any arbitrator who directed himself now on the hypothesis that it could not be a scaffolding would be misdirecting himself. The arbitrator in this case had come to the conclusion, as a matter of fact, that the arrangement was not a scaffolding. It was difficult to see how he could, on the decided cases, so find. But he was at large to consider whether it was a scaffolding or not. In his opinion the County-court Judge had pressed the decision of this Court in "Maude *v.* Brook" too far.

LORD JUSTICE STIRLING delivered judgment to the same effect.

November 14th.—Court of Appeal.—Plaintiff, Hathaway; defendant, the Argus Printing Company, Limited.—This was an appeal from an award of the Deputy-Judge of the City of London Court. The injured workman was a printer's cutter, and he brought this appeal for an increase in the amount of the award which had been made in his favour. He was in the service of the employers during four weeks. He entered into an agreement of employment with them by which he was to work for them on Thursday night and Friday night in every week at the wages of 8s. 8d. for each night. The employment was to be determinable by a week's notice. During the rest of the week he was free to work as he liked. Sometimes he worked at casual jobs for his employers, sometimes he worked for other masters. It appeared that his average weekly earnings from casual jobs for his employers were 14s., and his average weekly earnings from other masters were 8s. 8d. The Deputy-Judge made his award on the basis that the workman's "average weekly earnings" within the meaning of Paragraph 1 of the first schedule of the Workmen's Compensation Act were 17s. 4d., viz., the wages which he earned under his agreement with his employers. It was argued in support of the appeal, on behalf of the workman, that his earnings from casual jobs for his employers and his earnings from other masters ought to have been included, and that the award ought to have been made on the basis of his average weekly earnings being £2. There was a cross-appeal by the employers, who contended that the workman was not entitled to anything, on the ground that the employment was not continuous employment for at least two weeks.

The Court dismissed both the appeal and the cross-appeal.

The MASTER of the ROLLS said that, to begin with, it was clear that the workman was not entitled to have taken into account what he earned from other masters. On the other hand, he was entitled to have taken into account the 17s. 4d. which he earned under his contract. This Court had said that a workman, to come within the purview of the Act, must have been in his employment for at least two weeks, so that it might be possible to average his weekly earnings. But they had never said that he must be employed on every day of the two weeks. He could not see why the employment here, so far as regarded the agreement to work on Thursdays and Fridays, was not continuous employment. The Deputy-Judge was therefore right in taking into account the weekly earnings of 17s. 4d. With regard to the sums earned by the workman for casual service for his employers, he thought they ought not to be taken into account. There was nothing continuous about that service.

LORD JUSTICE COLLINS delivered judgment to the same effect.

LORD JUSTICE STIRLING concurred. With regard to the last question as to the sums earned by the workman from the same employers for casual services, he had some difficulty in seeing why they should not be included. But he would not differ from his learned brethen on that point.

NOTES FROM JAPAN.

(By our Special Correspondent.)

TOKYO, November, 1900.

Government contracts.—The regulations prescribed by the Department of Communications in connection with contracts for the Government Railways and other offices under the control of that Department, including some important recent modifications, have been published in a collected form, and will no doubt be of interest to many of your readers. Stripped of a good deal of verbiage and repetition, the main points are as follows:—

(1) The intending contractor must produce satisfactory evidence that he has been engaged for at least two years in the manfacture of articles or the execution of work similar to that for which he wishes to tender.

(2) In order to be qualified to compete for the supply of articles, the contractor—or one of the partners in an ordinary or limited partnership—must be a payer of direct national taxes according to the following scale:—

Amount of tender.	Tax paid per annum.
Under 5,000 yen	Not less than 10 yen
„ 10,000 „	„ 20 „
„ 20,000 „	„ 50 „
„ 50,000 „	„ 80 „
Above 50,000 „	„ 120 „

(3) A joint stock company must have a paid-up capital not less than twice the amount of the tender.

(4) Foreign companies must be duly registered, and must possess similar qualifications.

(5) A contractor tendering for lighthouse work must, in addition to the above qualifications, have a vacant space of ground adjoining his workshops large enough to admit the erection of a structure 60ft. square by 80ft. high, a cupola capable of melting a ton or more of iron at a time, a planing machine to take in bars 16ft. long, and a machine to bend plates 4ft. wide.

(6) A contractor for kerosene oil for lighthouse purposes, with a flashing point of 160 deg. Cent. or above, must be able to turn out 100 gallons or more per day; or for a flashing point of 140 deg. Cent. or above, 50 gallons or more a day.

(7) For the supply of railway material to be manufactured or tested in Europe or the United States of America, the contractor must have his main office, or a branch office or agency, in Japan, and also one either in Europe or the United States, and must produce evidence that he has satisfactorily and completely filled contracts for the supply of foreign-made railway material for Government or private railways to the amount of 100,000 yen or more in a single year during the three years preceding the invitation of tenders.

(8) A contractor—or one of the partners in an ordinary or limited partnership—competing for the construction of railways, buildings, or ships, must be a payer of direct national taxes according to the following scale:—

Amount of tender.	Tax paid per annum.
Under 5,000 yen	Not less than 5 yen.
„ 10,000 „	„ 10 „
„ 50,000 „	„ 20 „
„ 100,000 „	„ 30 „
„ 200,000 „	„ 50 „
Above 200,000 „	„ 80 „

(9) A contractor competing for building a ship of 1000 gross tons or more must have a yard and appliances of suitable capacity—including an annealing furnace—and must have had experience in the business.

(10) Written declarations as to the above qualifications, properly certified by the mayor or district or town headman—or in the case of those who have been engaged in trade abroad by their respective consuls—must be presented to, and approved by, the purchasing agents of the office inviting tenders, three days before the presentation of the tenders.

(11) No tenders will be entertained except those written on the forms furnished by the purchasing agents.

(12) The contractor must either be present personally, or be represented by a proxy duly furnished with the power of attorney, at the time appointed for opening the tenders.

(13) Six per cent., or more, of the amount of the tender must be deposited before the tender is lodged. This may either be in cash or in certain specified debentures or bonds, the value of which, for this purpose, is usually estimated at 90 per cent. of their face value. This deposit is at once returned to the unsuccessful competitors. If the successful competitor declines to complete the contract according to the prescribed forms his deposit is forfeited. If two or more tenders are of equal value, and lower than the rest, and one of the competitors declines to compete again, or puts in a higher tender, his deposit is forfeited. If the second tenders are also equal, and one of the competitors declines to let the matter be decided by lot, his deposit is similarly forfeited.

(14) The acceptance of tenders is decided on the lowest total price for the contract, and not by the value of individual items in it. If all the tenders are above the standard price fixed by the officials they are all rejected, and fresh tenders called for.

(15) Errors of calculation in the total value of a tender may be corrected conformably to the rate or unit value of each article included in a contract; but in no case will errors in the unit value be allowed to be corrected.

(16) The successful competitor must, before the exchange of the contract, deposit 10 per cent. of its value in cash or bonds as a security for its completion. Fines for late delivery are calculated on the basis of one-tenth of 1 per cent. of the contract value for each day's delay—or, say, 3 per cent. per month.

It will be evident from the foregoing conditions that only a few wealthy firms will be able to compete for a contract of any magnitude, as the tender or contract deposit itself becomes a matter for serious consideration.

Every item has to be priced out separately, and the rate, as well as the total amount of each must be stated, and the result is sometimes rather peculiar. For example, a contract for carriage fittings and trimmings may include some twenty or thirty items, such as leather and horsehair for seats, buttons, braid, window glass of three or four sizes, india-rubber body blocks, a score or more of different sizes of wood screws, &c. &c. The inquiry for a tender is usually published only five or six weeks before the date of competition, so that a merchant in Tokyo has only just time to send home the specification to his agent in London or elsewhere, and for the latter to collect prices from the approved makers on the Government list, and telegraph the total price, or perhaps the price of three or four groups, to Tokyo. The cost of cabling each individual item would of course be prohibitive. The merchant has then to subdivide these lump prices among the individual items to the best of his judgment, and fill in the results on the printed tender form which is considerably abbreviated from the specification. For example, the twenty sizes of wood screws will be entered as:—

634 gross screws at.....per gross, £..:.:....
400 panes glass at.....per pane, £..:.:...

ignoring the fact that each size of screws, or of panes, will have a different value. But as the total amount is what determines the acceptance or rejection of the tender, the detailed prices are usually purely imaginative, and frequently wildly wrong, and cannot be of much service in helping the officials to estimate their standard price for the next contract.

As the money annually voted by Government for each department, or sub-department, must be spent during that financial year, ending March 31st, or returned to the Treasury, and as, of course, no payments are made until the goods are finally accepted, late delivery extending into the next financial year will involve endless complication.

There is a twofold inspection of goods, the first being at the maker's works, and carried out by inspectors appointed by the department, and the second being after delivery in Japan, and nominally dealing with the quantities actually supplied, and any damage that may have occurred during transit; but goods are not infrequently rejected on the score of inferior quality, even although they may have passed the first inspection.

A curious Customs case.—Some time last March the Crown Distilleries Company, of San Francisco, sent a barrel of "white rye whisky" to the American Trading Company, of Yokohama, as a sample. This was assessed by the Customs at the ordinary rate of 40 per cent. *ad valorem* imposed on whisky, brandy, rum, and the like. Mr. Morse, the president of the American Trading Company, finding that there was likely to be a large sale for it, submitted a sample to the superintendent of the Yokohama Customs, requesting him to make a special examination of it, and to report what was the actual duty chargeable. In return he received an official written reply to the effect that it would come under Article 396 of the Import Tariff, and that consequently 40 per cent. was the correct duty. A consignment of 400 barrels was passed by the Customs at this rate, but when a second shipment of 750 barrels arrived, the classification was arbitrarily and without notice changed to alcohol, and the duty charge raised to 250 per cent. Thereupon Mr. Morse appealed to the Minister of Finance, pointing out, among other arguments, that according to Japanese law a liquid containing below 65 per cent. of alcohol is not classed as alcohol, and that it was admitted that the liquid in question contained only 62·3 per cent. of alcohol, and had been passed as whisky by the United States Customs, the brand "whisky" having been burned into the barrels, not by Mr. Morse or any of his agents, or even by the company that sold and shipped it to him, but by the expert excise officers of the United States Government, after a test under a requirement of law, at the time that the liquor was withdrawn from the Government bonded warehouses in Illinois, and were checked by Government expert officers at San Francisco at the time of export. Official certificates were put in showing the reports of these officers on the testing and branding, and covering every barrel shipped. It was therefore manifestly impossible that he, Mr. Morse, could have been a party to any collusive arrangement under which the trade name of the liquor, which was the official trade name in the country of origin, should be improperly given. His sole request was that the Japanese authorities should apply to the goods the test prescribed by Japanese law to goods coming in as whisky. He further pointed out that there had been no allegation or imputation that the second consignment, which actually belonged to the same order as the first shipment, was in any respect of a different quality to the first.

The decision given by the Minister of Finance, which was adverse to the appellant, was based mainly upon three grounds: First, that so far as the official charged with the examination of the goods could remember, the quality of the second shipment was not the same as those previously submitted. Secondly, that the letter sent by the Superintendent of Customs in answer to the appellant's inquiry as to the scale of duty had no legal effect, and was not binding on the Customs. Thirdly, that Clause II. of Article I. of the Customs Regulations fixing the limit of alcohol at 65 per cent. referred only to liquids belonging to the class of Japanese *saké*—a spirituous drink—and that as the liquor in question is destitute of the flavour of whisky, and does not contain the proper mixture of acid, extract, and alcohol found in ordinary *saké*, it does not come under that class, and is nothing but diluted spirit, or alcohol mixed with water.

Although this is the most important case that has yet arisen, it is by no means a solitary one. For example, a sample of cloth woven of two different materials is submitted to the Customs superintendent, who classifies it as coming under a certain description; but the merchant who contracts to supply a given quantity to a purchaser at a given price may find when his consignment arrives that it is assessed under another and a considerably higher tariff.

Iron or steel plates, angles, bars, &c., are assessed at a certain rate, but if they have any work put on to them, such as cutting, flanging, or punching, the duty jumps up to 20 per cent. A boiler sent out in plates to be riveted up here would be assessed at that rate, while a boiler sent out whole would only be charged 10 per cent. In the case of a gasworks installation, the superintendent was asked what would be the duty on the gasholder, which, of course, would have to be shipped in separate plates, and he replied that on production of a certificate that the whole consignment belonged to one installation, it would be admitted at the machinery tariff of 10 per cent. all round; but it is by no means certain that the officer who has to pass the goods will take the same view, and as has been seen above, even a written opinion of the superintendent has no legal effect, and is not binding. The same class of goods, landed partly at Kobe, and partly at Yokohama, will sometimes be assessed differently; and it is generally more politic to grin and bear it, rather than to run the chance of having both lots assessed on the higher scale.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

Water supply tunnels of Chicago.—The city of Chicago, which has a population of 1,750,000, draws its water supply from Lake Michigan by means of ten tunnels extending under the bed of the lake for two to four miles, and terminating in five vertical intake shafts. Above the bed of the lake these shafts are carried by iron cylinders to the surface, the cylinders being within the wells of intake cribs surmounted by lighthouses, and quarters for the crib keepers and light keepers. The water of the lake enters the well by ports through the cribs, and thence enters the cylinders by gates or openings, which can be closed at will. Some of the cribs are of timber construction, with walls 25ft. thick, and others are made of two concentric steel caissons, 123ft. diameter outside and 70ft. inside, the annular space being divided by radial steel bulkheads, and filled with concrete. The depth of water at the cribs is about 40ft. The first waterworks were established in 1840, the population then being only 4500. The first tunnel was commenced in 1864, and was put in service in 1867, and the second in 1875. In addition to the intake tunnels proper, there are other tunnels extending under the city, connecting the lake tunnels with the several pumping stations. The following is a list of the intake tunnels under the lake:—

	Diameter, feet.	Length, feet.	Cost. £.	Capacity, gallons.
1..	6	10,000	140,360	45,000,000
2..	5	10,567	92,973	170,000,000
3..	7	10,560	88,142	
4..	7	10,908	59,980	
5..	8	9,139	220,950	95,000,000
6..	6	23,200		
7..	7	12,353		
8..	5	8,132	148,300	105,000,000
9..	6	5,026		
10..	10	14,108	122,112	200,000,000
Total (21·97 miles)		115,993	867,800	615,000,000

Strengthening the Niagara cantilever bridge.—The Michigan Central Railroad cantilever bridge over the Niagara River has been strengthened on account of the steady increase in engine loads, train loads, and traffic. The bridge has two steel framed towers on masonry pedestals, with a channel span of 469ft. 8in. between towers, and shore cantilever arms of 195ft. 3in. The depth of the cantilevers over the towers is 56ft. The bridge is a deck structure, with trusses 28ft. apart, with two tracks, and the rails are 240ft. above the water. The cantilever trusses are 396ft. 3in. long over all, and the central suspended trusses are 120ft. long. The floor system was proportioned for 78-ton engines with eight coupled wheels and a two-wheeled bogie, and the structure as a whole was proportioned for a live load on each line of a train load of 2000 lb. per lineal foot, drawn by two engines with 36 tons on the driving wheels. The bridge was completed in 1883. It has been reinforced by the addition of a new central truss, supported on its own columns and pedestals between those of the two original trusses. In erecting the columns or towers it was desired to avoid cutting the transverse bracing, and the sides were therefore placed separately, the latticing and tie-plates being riveted up in the field. The new truss is intended to be 50 per cent. stronger than either of the old trusses, and its members are designed to give the same deflection at each point as in the old trusses, assuming that three-sevenths of a load on each track will be carried by the new truss and four-sevenths by the old trusses. The material used is open-hearth steel; ultimate strength, 66,000 lb. to 74,000 lb.; elastic limit, 55 per cent. of ultimate strength; elongation, 22 per cent.; reduction of area, 45 per cent.; fracture, silky. The sulphur content was limited to 0·04 per cent., and phosphorus to 0·04 per cent. for basic, or 0·075 per cent. for acid steel.

St. Lawrence electric power plant.—At a point on the St. Lawrence River, near Massena, some distance below the Niagara Falls, an extensive power plant has been established, and is now approaching completion. While the Niagara plant has ten generators of 5000 horse-power, the Massena plant will have fifteen generators of the same power. The former, however, has horizontal turbine wheels on vertical shafts, while the latter will have turbines revolving in a vertical plane, with horizontal shafts coupled directly to the generator shafts. Nearly parallel with the St. Lawrence at this point, and separated from it by two ridges, is the Grasse River, which serves as the tail race, a canal three miles long having been built from the St. Lawrence to the power-house on the banks of the Grasse. The total available fall is only about 40ft., but the volume of water is greater than at Niagara. Each generator will be driven by six Victor turbines, in three sets of two pairs, the group of six developing 6000 horse-power. There will also be three smaller turbines operating three direct-current generators, used as exciters for the main generators. The generator shaft carries the revolving field, 15ft. diameter and 3ft. wide, making 150 revolutions per minute, with a peripheral speed of about 1¾ miles per hour. The field is very massive, in order to act as a fly-wheel, and has twenty pole pieces. All the operations of the machinery will be controlled from a central switchboard. The building is 700ft. by 150ft., 60ft. high, with an 85-ton travelling crane running its whole length. The current generated will be used for a variety of purposes. It is adapted for induction motors, lighting and heating, and electrolytic work, and also for electro-chemical processes, such as the manufacture of aluminium, calcium carbide, &c. For these purposes the plant is well located, different railways being near at hand, while the canal is navigable for large lake steamers.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

BUYERS this—Thursday—afternoon in Birmingham attempted to make the most of the character of the accountants' certificate to the Iron Trade Wages Board issued at the close of last week. This showed a drop of 3s. 8d. per ton in the average of the selling price realised for manufactured iron during the months of July and August last. The accountants certified the average net selling price to have been £9 15s. 0·49d. per ton. The statement of the different classes of iron sold and the average net selling prices was as follows:—

	Tons.	Price. £ s. d.
Bars	18,986	9 16 1·72
Angles and tees	858	10 1 2·80
Plates and sheets	953	10 16 9·46
Hoops, strips, and miscellaneous	5,390	9 6 3·90

The total quantity is therefore 26,189, as compared with 21,787 for the months of July and August, and the selling price shows a decrease of about 3s. 8d., compared with the previous ascertainment, which was £9 18s. 8·10d. Compared with the return for May and June last, there is little or no change, the current figures being practically the same as for the months just mentioned.

The present decline is the first recorded for about two years, and in this respect it corresponds to some extent with the experience of the Scotch Wages Board; but in the North of England, to the surprise of those interested, the returns show another increase. In one respect the local return is more satisfactory than the last. The output of the selected firms has increased by close upon 4500 tons. In accordance with the sliding scale, the rate of wages for puddling remains at 11s. 3d. per ton, and millmen's wages in proportion. While, therefore, it does not bring ironmasters the relief of which they are so badly in need, the Wages Board announcement imposes no fresh burdens upon the industry. It will be remembered that two months ago the men were entitled to a 2½ per cent. advance, which their representatives agreed to abandon. Had they persisted in retaining that to which they were entitled, the figures just announced would have meant a reduction. No change having been made in the wages of the men at the mills and forges, the wages of blast furnacemen will also remain unaltered for the next two months.

Ironmasters report this week sufficient orders on the books to keep the works engaged till the end of the year. Neither merchants nor consumers, however, will place orders for next quarter's requirements at present prices. From the quiet tone that has lately prevailed, some revision of present rates is regarded as very probable at the January quarterly meetings. Indeed, an almost immediate reduction in second and third-class bars by the Unmarked Bar Iron Association is anticipated, following upon the reduction which was declared by this association immediately proir to the late reduction in marked bars. One of the greatest needs for further ease in selling prices is the continued competition of foreign makers in the export markets, particularly Australia, India, South America, and some other countries that might be named.

There is some relief to the bar and iron sheet makers in the easier rates accepted for pig iron; but the marked bar makers, who reduced their minimum from £11 10s. to £10 10s. early in November, state that they see no immediate further prospect of lower prices, coal being still—nominally at any rate—about double the old rates, whilst the best pieces of finished iron are £10 10s., compared with the once prevailing rates of £7 10s.

The weakest section of the trade is the common bar department, which has been declining for the last three months, the chief reason being what is called "reckless competition." The nominal price of unmarked bars is £9 10s., but this figure has not lately been realised, sales this week being mentioned at £8 and under. Hoop iron is quoted £9 to £9 10s., nail-rod and rivet iron £9 5s. to £9 15s., and tube strip £8 5s. to £9.

Iron sheets are very irregular, though some makers are obtaining 2s. 6d. a ton over recent rates, owing to curtailment of output. Sheet, singles, are £8 12s. to £8 15s.; doubles, £8 15s. to £9; and trebles, £9 7s. 6d. to £9 10s. Galvanised corrugated sheets are £12 10s. Best sheets for stamping purposes are selling at about £12.

The reduction of the output of pig iron continues. It is this week reported that, owing to the continued fall in prices, it has been decided to blow out further blast furnaces in the Northampton and Derbyshire districts, and in North Staffordshire. Prices of forge and foundry pigs now show a decline of as much as 16s. to 17s. 6d. per ton from the late boom maximum. Northampton and Leicestershire grey forge pigs have gone down to 57s. 6d. to 60s., and North Staffordshire 60s. to 62s. 6d. Derbyshire forge pigs are quoted at date 58s. 6d. to 61s., while Staffordshire pigs are quoted: Cinder forge, 60s.; part-mine, 62s. 6d. to 65s.; all-mine, 65s. to 77s. 6d.; best ditto, 90s. to 95s.; foundry ditto, 100s.; and cold blast, 120s.

Although the above are current quotations they are really scarcely more than nominal, since to obtain orders sellers are willing on every hand to make concessions from market figures. Smelters find a very small sale for pig iron, and the prices offered by consumers are such as to leave little, and in some cases no profit.

A remarkable statement is this week being made regarding American pig iron imported into this district. It is said that although the first deliveries were of very good quality, much of the iron sent over has since been inferior, and in some cases it is even alleged that buyers have been compelled to throw it on the scrap heap. The statement is certainly a remarkable one; indeed, it may almost be characterised at sensational; nevertheless it is alleged to be accurate. The circumstance encourages local producers to believe that they will hear rather less of American competition in the future, especially as the margin in favour of the imported article has been reduced. Local prices have now been brought closer to the level at which foreign-made iron has been sold.

Great interest is manifested this week in the coal trade situation. Judging by what is taking place in South and West Yorkshire, the Forest of Dean, and some other districts, the end of the coal boom has come at last. If this be so, then a declared reduction cannot be long delayed in Staffordshire. This at present has not occurred, but it is beyond question that this week rates are easier. Quotations at present are still named at:—Thick coal for blast furnace purposes and best manufactured ironworks use, 15s. to 17s. 6d.; house coal, lumps, 18s. to 20s.; second qualities, 15s. 6d. to 16s. 6d.; steam fuel, 12s. 6d. to 15s.; and rough slack, 8s. 6d. to 9s. 6d. In the absence of business, however, pending the anticipated reduction, these prices were largely nominal. Gas cokes are 21s.; hard cokes, 25s. to 26s.; and best foundry cokes, 35s. per ton.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The collapse in the iron trades is becoming more and more complete, and is causing serious apprehension as to the future. The most unsatisfactory feature, as I previously pointed out, is that the very large reduction that has now taken place in prices, and which both makers and manufacturers declare has brought about a position that they have to face an absolute loss on production, utterly fails to bring forward increased buying. Merchants seem only determined to put a still further "squeeze" upon makers and manufacturers by abstaining as much as possible from buying. As an illustration, a merchant mentioned to me the case of one Lancashire manufacturer. Usually their account with them ran into not less than about £2000 per month. This last month, however, it had amounted to only £20, and that was the policy they would continue to follow, as they had found other channels from which they could obtain supplies, and these to a large extent were foreign.

As to the fuel and wages question, which largely dominates the situation so far as makers and manufacturers are concerned, there is still no prospect of any early relief. Further increases of miners' wages have in fact to come into operation within the next couple of months, and the weakening tendency in some directions, which was becoming noticeable a few weeks back, is now decidedly less evident, and there would seem to be very little probability of any appreciable easing down in fuel prices for the next three or four months the anticipations which in some well-informed quarters are entertained being that towards the close of March it is not unlikely there may be the beginning of a downward move. This, of course, is quite problematical, and very much will depend on the character of the winter, but there is practically a consensus of opinion that coal prices have, at any rate, touched the top.

The outlook in the engineering trades continues much as I have reported recently. Visiting some of the principal machine tool makers in the district, the general conclusion arrived at was that whilst in most cases there was plenty of work passing through the shops, and sufficient in some instances to keep them well engaged over the next three or four months, there were, as a rule, comparatively few new orders coming on the books. One or two special branches, such as electrical engineering and locomotive building, are not experiencing any slackening off, and are likely to be extremely busy for a long time ahead. With regard to locomotive building, I may mention that the representative of one of the large Lancashire firms stated to me that the sending out of orders some twelve months back to the United States had perhaps been one of the best things that had happened to the trade, as the result had been so much dissatisfaction with American work that there was now no question about placing orders with English firms.

The continued downward move both in raw and finished material is completely disorganising the iron market here, and a general absence of demand was the report at Tuesday's 'Change meeting in Manchester. Merchants buy small lots at the bottom prices to cover pressing deliveries on account of previous "bear" sales, and consumers purchase only as they are absolutely compelled, the transactions all through representing but a very insignificant weight of business. This is particularly the case with regard to pig iron, the renewed downward tendency in prices during the past week, if possible, restricting buying to still more limited dimensions than ever. Local and district makers, at their list basis rates, which remain nominally unchanged, are practically out of the market, owing to merchants being ready to snap up any orders at much below their quoted rates. For Lancashire foundry pig iron makers are quoting about 72s. 6d., less 2½, delivered Manchester, but are practically booking little or nothing in the way of new business. For Lincolnshire No. 3 foundry makers' basis prices remain at 64s. 6d. net, with merchants' sellers at 63s. 6d. net; and Derbyshire ranges from about 68s. to 69s. net, delivered Manchester. Forge qualities are so little inquired for that quotations are only nominal at about 63s., less 2½, for Lancashire; 61s. 8d. net for Lincolnshire; and 60s. 6d. to 61s. 6d. net for Derbyshire, delivered Warrington. In Middlesbrough iron there has been a very decided drop since last week, and even makers' quotations are reported as low as 69s. 10d. to 70s. 4d., whilst some merchants would be prepared to book at as low as 68s. 4d. net by rail Manchester. Scotch iron, although makers' prices are not actually quoted lower to any appreciable extent, are also easier, and, delivered Manchester docks, might be bought through merchants at about 73s. 6d. net for Eglinton and Glengarnock, with American pig iron still quoted about 63s. 6d.

The position in the finished iron trade remains without material alteration. The official reduction of 10s. per ton on Lancashire bars, announced last week, has become general, and delivered Manchester district, basis prices are now £8 for Lancashire, and £8 to £8 5s. for North Staffordshire bars; sheets average about £9 5s. to £9 10s., with list quotations for hoops for the present remaining at £9 2s. 6d. for random to £9 7s. 6d. for special cut lengths, delivered Manchester district, and 2s. 6d. less for shipment. There is, however, no appreciably increased weight of buying coming forward, and forges continue very badly off for work to keep them going.

Prices in the steel trade continue to show a downward tendency. Hematites are now being quoted about 86s. to 88s., less 2½, for No. 3 foundry delivered here. For local-made billets makers would take about £5 12s. 6d. to £5 15s. net. The ordinary light sections of steel bars range from about £8 to £8 10s., but heavy sections could be bought as low as £7 10s. to £7 12s. 6d., with common steel plates also about £7 10s. to £7 12s. 6d., and boiler plates offering freely at £8 15s., in anticipation of a reduction in the association list rates, which recently have been little more than nominal as regards actual business of any moment doing.

Passing through a large engineering works in the Manchester district the other day, I was struck by the very singular appearance of everything about the shop, which under the bright electric light looked for all the world as if a sharp and severe snowstorm had visited the entire establishment. I was informed that this had been brought about by the ceilings having been whitened with the aid of a pneumatic spray painting apparatus. The result was that the lime and water being directed on to the ceiling in a sort of vapour, had diffused itself all over the shop, settling in the form of a driven white coating upon belting machines, materials, and in fact on everything throughout the premises. This may, perhaps, be useful information, supposing similar experiments may be tried elsewhere.

The coal trade is maintaining the improvement to which I referred in my notes last week, and although quoted list rates remain unchanged, the tendency of prices is in some respects stronger. The better qualities of round coal are meeting with sufficient demand to take away the output of the collieries, so that stocks, which remain extremely low for the time of the year, are not accumulating to any appreciable extent, and prices are firmly maintained at the full list basis. Common round coals continue in fairly good demand for steam and forge purposes, and prices are maintained on the basis of about 12s. 6d. to 13s. at the pit. The chief improvement in the position is with regard to engine fuel. A number of important contracts are still held in abeyance, and large users are preferring to go on buying practically from hand to mouth, but colliery proprietors are not at all pressing, as they are of opinion that supplies of slack are likely in the immediate future, at any rate, to be less plentiful rather than otherwise, and they are holding firmly to their prices. There are still surplus lots of slack coming on the market at low figures from other districts, but these are not being offered quite so freely as recently. Lancashire quoted pit prices remain firm on the basis of 10s. to 10s. 6d. per ton for the better qualities of slack.

For shipment only a very indifferent demand comes forward, and ordinary qualities of steam coal, delivered Mersey ports, are readily obtainable at about 15s. 3d. per ton, although 6d. to 9d. per ton above this figure is occasionally being got for some of the better qualities of round coal.

For the better qualities of foundry coke makers are still able to maintain late rates on the basis of about 28s. to 30s. at the ovens. The lower descriptions of coke for furnace purposes remain, however, weak, and in some cases Yorkshire coke has been offered at about 14s., although the association list rates still remain at 15s. per ton at the ovens.

Barrow.—The hematite pig iron trade is quieter, although the position of makers is not materially changed. The demand, however, has fallen off, and there is less business doing. Makers quote Bessemer mixed numbers at 75s. 6d. to 78s. per ton net f.o.b., the lowest price they have touched for some months past, and warrant iron sellers are at 74s. 3d. net cash, buyers 3d. less. It is significant that the stocks of warrant iron held in the district, which have been on the down grade for several weeks past, have this week shown an increase of 781 tons, the stocks in hand now representing 26,971 tons, being a reduction since the beginning of the year of 170,876 tons. There has been no increase in the make of pig iron, only thirty-seven furnaces being in blast and of these two are engaged on spiegeleisen. In the corresponding week of last year forty-seven furnaces were in blast.

Iron ore is in steady demand on local account especially, and good average sorts are quoted at 17s. per ton net at mines, while Spanish ores of good quality are at 18s. net at West Coast ports.

In the steel trade there is a poor business doing, and makers are not well off for orders, but prospects are better for next year. At present it is uncertain how long the activity at the mills will be maintained, as makers are not being pressed for deliveries. Steel rails of heavy sections are nominally at £6 10s. per ton, but big parcels could be bought at £6 per ton. Heavy ship plates are £7 nominally, but lower prices could be negotiated for big parcels of metal. Hoops, billets, and merchant steel are in good demand, but tin bars are quiet.

Shipbuilders and marine engineers are busy on old contracts, but no new orders are reported.

The coal and coke trades are easier, and supplies are so full that a further and substantial reduction in prices is to be looked forward to.

The shipments from West Coast ports during last week represent 7280 tons of iron, and 12,551 tons of steel, as compared with 11,906 tons of iron, and 11,878 tons of steel in the corresponding week of last year, a decline in iron of 4626 tons, and in steel an increase of 673 tons. This year the exports have reached 590,224 tons of iron, and 378,949 tons of steel, as compared with 489,956 tons of iron, and 452,930 tons of steel in the corresponding period of last year, an increase in iron of 100,268 tons, and in steel a decline of 73,981 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE South Yorkshire coal trade continues in a quiescent condition, the weather keeping unusually mild, and thus preventing anything like a winter demand. Coalowners, however, hold stiffly to current quotations in the belief that frost and snow must soon come, and with the knowledge that there are before them further advances in miners' wages, which do not encourage any lowering of quotations. Several railway companies are now in the market for supplies for the half year commencing in January next. Coalowners are prepared to make a concession of 1s. a ton—taking, that is, 15s. instead of 16s.—and tenders to the railway managers are being made on this basis. The railway companies do not appear to be in a hurry to make up their minds, although intimation has been made in several quarters that the offers are not good enough; owners are encouraged to stand out against any further concessions by the knowledge that one of the leading railway companies, which declined to contract last season, had to pay a good deal more in the open market. For house coal, best Silkstones are still quoted at 15s. to 16s. per ton; Barnsley house, 14s. to 15s. per ton.

In steam coal demand continues steady on inland account, the railway companies requiring full contracted weights, while the request for general trades is well sustained. Barnsley hards are quoted 15s. to 16s. per ton, and it is stated that business for forward delivery is being done at these figures. Gas coal, as is usual at this season of the year, is being freely called for. A rather better tone is perceptible in engine fuel, the downward tendency in values having been checked. Nuts are now making 9s. 6d. to 10s. 6d. per ton, screened slack from 7s. 6d. per ton, and pit slack from 6s. 6d. per ton. Black furnace coke fetches from 17s. to 18s. 6d. per ton, foundry coke 28s. to 30s. per ton, and coke for steel melting purposes 30s. Values are very irregular, trade being considerably weaker, owing to lessened requirements in iron circles.

In the iron market business is being conducted from hand to mouth; although values have again fallen—hematites to 85s. and common forge to 60s. per ton—they are not low enough to encourage consumers to accumulate stocks. In Swedish material there has been more animation, partly owing to the firmness which has followed American business since the Presidential election closed. Trade is now pretty firmly assured in the States, and consequently purchases are made with more confidence. Values keep very steady, and it is difficult in any circumstances to obtain concessions, Swedish manufacturers with abundant work having no inducement to lower values. Indeed, they state most confidently that no changes of any importance are likely to be made for a very considerable time.

Amongst the work recently placed by the War-office for military material, Vickers, Sons, and Maxim, Limited, River Don Works, Sheffield, have received an order for forty-two 4·7 guns and the necessary limbers and carriages. The guns are to be made at Sheffield, and the limbers and carriages at Barrow-in-Furness. The War-office have also ordered from Messrs. Vickers three 5in. howitzer batteries, together with wagons, limbers, and carriages. The same firm are at present employed in making twenty-seven garrison mountings, on which will be fixed Vickers' 9·2 guns. The firm have also in hand guns and mountings for the following battleships and cruisers:—Irresistible, Venerable, Albemarle, Euryalus, Bacchante, and King Alfred, for the British Admiralty, as well as the twin 6in. guns with mountings complete for the new British cruisers Monmouth, Bedford, Kent, and Essex. They are also making the guns and mountings for the Turkish warship Messudjah.

In the lighter departments of Sheffield industry business is quieter than it was during the corresponding period of last year. At this season manufacturers ought to be well occupied all round upon Christmas and New Year orders, but there are complaints in various quarters that work is not coming forward to the extent desired or required. A feature of December trading is the falling off in the demand for the best classes of ivory-handled cutlery. The call for secondary grades, on the other hand, is rather better, and in several instances manufacturers of these goods can scarcely make deliveries as quickly as the market demands. A grievance frequently mentioned is scarcity of workmen; it is, indeed, one of the chief causes why a sudden accession of orders cannot be quickly dealt with. The silver-plating trades are in a somewhat similar condition, the season demand from London and the principal provincial centres being short of what it usually is. The ivory sales for 1900 are over, and the result has been that only 32 tons were sold at Liverpool, and in London 294 tons found purchasers. Antwerp has this year been the largest ivory market, 325 tons having been sold there. It is expected that the position Antwerp has now taken will be successfully held for some years, owing to the increased consignments which may be looked for from Central Africa, where the Congo Company has been able to extend its sources of supply in the territories recently obtained from France.

NORTH OF ENGLAND.

(From our own Correspondent.)

HOWEVER much one may be disposed to look on the bright side of trade, it is unfortunately almost impossible now to find anything that is favourable; indeed, the general tone of business is quite pessimistic, and presents altogether a striking contrast to the state of affairs even so recently as the early part of the current half year. The pig iron market is quite disorganised, prices have fallen practically every day during the past fortnight, with the natural result that no one will buy who can put off. When, within a week, pig iron prices drop 3s. 6d. per ton, business of any moment cannot be expected. The "slump" is most marked in pig iron. Cleveland brands have declined 11s. 6d. per ton since prices began

their downward course in July, and now they are at figures lower than any that have been reported since March, 1899, while the indications are that still lower rates may be expected, as the outlook continues unsatisfactory. Pig iron shipments are very poor; local consumption is declining, and will be further reduced at the end of the month by the Christmas holidays, which will be more prolonged and more generally observed than usual, because orders have ceased to be pressing. Stocks are already increasing at a great rate, not only in the public warrant stores, but also in the hands of makers themselves, and it is chiefly their pressing sales that is leading to prices receding so quickly. Pig iron shipments this month are only at the rate of about 700 tons per day, whereas the daily average for the year up to the end of November was over 3800 tons. When this is taken into account, as well as the fact that stocks are increasing so heavily, it is not surprising to hear of furnaces being put out. The Cargo Fleet Iron Company, Middlesbrough, is blowing out two furnaces, and Bolckow, Vaughan, and Co. will blow out one this month, these three reducing the output of the district by nearly 8000 tons per month.

No. 3 Cleveland G.M.B. pig iron has fallen to 60s. per ton for prompt f.o.b. delivery, and sellers have great difficulty in getting even that rate. No. 3 iron, which is the quality that is mostly shipped to the Continent, has felt very severely the close of the navigation season, and the value has fallen more quickly than have the prices of the lower qualities. Not long since grey forge was 4s. 6d. per ton cheaper than No. 3; now it is but 2s. less, consumers having to pay 58s. for it, while they give 59s. for No. 4 foundry, and it looks as if the old proportions of prices would very shortly be reported. No. 1 has been reduced to 61s. 6d., and it is relatively cheaper than No. 3. Hematite pig iron has not fallen quite so much this week as Cleveland iron—about 2s. 6d.—and while most of the business in mixed numbers has been done at 76s., there have been offers to sell at 75s., which have hardly been responded to, though it is fully 12s. per ton below the year's best price, thus exhibiting a decrease of at least 14 per cent. Cleveland iron is 16 per cent. below the best, which is a higher rate than the reduction in materials, and wages have increased rather than decreased, there being no reductions yet at either blast furnaces, ironstone mines, or limestone quarries. Rubio ore is obtainable at 18s. per ton, delivered at wharves on Tees or Tyne.

At the close of November the stock of Cleveland pig iron in Connal's warrant stores was 24,239 tons, 8795 tons, or 57 per cent., having been added during the month, this being a larger increase than has been reported in any month for more than two years. Their stock of hematite pig iron has stood at 555 tons since the middle of July. The stock of Cleveland iron in the North-Eastern Railway Company's warrant stores has begun to increase somewhat rapidly; during the first half of the year the stock in these stores was nil, but at the close of November 11,090 tons were reported, 3590 tons increase, or 48 per cent., being reported during the month. This makes the total stock to have increased 12,385 tons during the month, a larger increase than has been shown for some years.

The shipments of pig iron from the Cleveland district during November were disappointing, reaching only 82,042 tons, which is a smaller quantity than has been reported in any other month this year except February, and it compares with 112,294 tons in November, 1899. The decrease has been 27 per cent., the most marked falling off being in the coastwise deliveries, which were 41 per cent. behind those of the corresponding month last year, reaching only 22,691 tons. The oversea deliveries were 59,531 tons, the decrease being about 20 per cent. Only 16,963 tons were sent to Scotland, whereas in November last year the quantity was 30,804 tons. In Germany, 36,805 tons were despatched, against 46,206 tons in November, 1899, and a smaller shipment has not been recorded since last February. France and Germany have also reduced their consumption of Cleveland iron. Altogether 1,070,867 tons of pig iron have this year been shipped from the Cleveland district, 189,948 tons, or 15 per cent. less than in 1899, the quantity being also surpassed in 1896 and 1897. The deliveries over sea, 779,513 tons, were only 2 per cent. less than in 1899, but the coastwise, 291,394 tons, were 174,086 tons, or 38 per cent. less, and are the smallest reported since 1892.

The death has been announced within the last few days of Mr. Thomas Vaughan, who was the son of Mr. John Vaughan, one of the founders of the well-known firm of Bolckow, Vaughan, and Co., and of the Cleveland iron trade; indeed, it was he who in May, 1850, was the discoverer of the main seam of Cleveland ironstone. Mr. Thomas Vaughan was himself a large ironmaster; in fact, at one time he owned more blast furnaces than any other firm in the country. It was at his Southbank Works, near Middlesbrough, that the experiment was tried of raising the height of blast furnaces from 60ft. to over 81ft., and it proved successful. He also owned and worked the Bishop Auckland and Whessoe Works, both finished ironworks which have long since disappeared. Mr. Thomas Vaughan, who was born in 1834 at Walker-on-Tyne, where his father was manager for Messrs. Lord, Wilson, and Bell, inherited over a million when his father died in 1868; but in the bad times that followed 1874 misfortune overtook him, and he retired from the iron trade, and has been out of business since about 1877, having been for many years an invalid.

The manufactured iron and steel trades are quiet, but producers, having reduced their quotations to figures which they believe will enable them to contend successfully with foreign competition as well as the competition of other British districts, refuse to ask or accept any lower rates. German plates have this week been offered to local consumers at £6 17s. 6d. per ton f.o.b., Antwerp, but they can do better than that by dealing with producers at home. The reduction that has been made in the prices of plates has enabled shipbuilders to lower their quotations for new steamers enough to bring shipowners forward, and it is reported that two of the Tyneside builders have booked orders for ten steamers for foreign owners within the past fortnight, while another firm has secured orders for four. Iron and steel ship platesand angles are steady now at £7, steel boiler plates at £9 15s., iron boiler plates at £9 5s., steel hoops at £9, iron sheets at £9, steel sheets at £9 10s., common iron bars at £8, best bars at £8 10s., and double best bars at £9, all less 2½ per cent. f.o.t. Heavy steel rails could be bought at £6 net at works, but small lots could not be had at that figure.

The coal trade has become decidedly easier, and some collieries have had to stand idle which have been in full work for years. Orders are less readily obtainable, shipments have slackened, and nearly all prices have been reduced. Best steam coals have gone down to 14s. 6d. per ton f.o.b., and smalls to 8s., while gas coals have been disposed of at 15s. 6d. per ton f.o.b. Coking coal has dropped in value, but it is still relatively dearer than coke itself, and some of the coalowners rather sell it than convert it into coke. For medium coke about 19s. per ton at the furnaces on Teesside is accepted, this being 10s. below the price ruling at the commencement of the half-year.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

BUSINESS in the Glasgow pig iron market this week has been almost confined to Scotch warrants, and these have been bought almost exclusively for cash. There are some speculative operations proceeding, and until it is seen how these are likely to finish, consumers and merchants do not care to buy for future delivery. Business has been done in Scotch warrants from 68s. 2d. to 67s. 6d. cash. Cumberland hematite was done at 75s. 9d. to 75s. cash, and 75s. 3d. one month, but the dealings in this class of iron were small. There was practically nothing doing in our market in Cleveland pig iron.

The output of Scotch pig iron is well maintained, and the current reduction in stocks is comparatively small. While this is so, the existing stocks are so small that any sudden demand might not be very easily met without materially enhancing prices.

The following are the current quotations of Scotch makers' pig iron:—Govan, f.o.b. at Glasgow, No. 1, 69s. 6d.; No. 3, 68s. 6d.; Carnbroe, No. 1, 71s.; No. 3, 69s.; Clyde, No. 1, 78s. 6d.; No. 3, 69s. 6d.; Gartsherrie, No. 1, 80s.; No. 3, 70s.; Calder, No. 1, 80s. 6d.; No. 3, 70s.; Summerlee, No. 1, 84s.; No. 3, 70s. 6d.; Coltness, No. 1, 86s. 6d.; No. 3, 70s.; Glengarnock, at Ardrossan, No. 1, 80s. 6d.; No. 3, 69s.; Eglinton, at Ardrossan or Troon, and Dalmellington at Ayr, Nos. 1, 70s. 6d.; Nos. 3, 69s.; Shotts, at Leith, No. 1, 84s. 6d.; No. 3, 70s. 6d.; Carron, at Grangemouth, No. 1, 80s.; No. 3, 70s. per ton.

For Scotch hematite there is a fairly good demand, and merchants quote 82s. 6d. per ton for delivery in railway trucks at the steel works.

The shipments of pig iron from Scottish ports in the past week were 5387 tons, compared with 6405 in the same week of last year. The total shipments to date are 305,344 tons since the beginning of the year, against 249,680 tons in the corresponding period of 1899. The past week's shipments embraced, to Canada, 25 tons; India, 66; Australia, 80; France, 20; Italy, 350; Germany, 345; Russia, 70; Holland, 1232; China and Japan, 360; other countries, 228; the coastwise shipments being 2611 tons, against 2677 in the same week of last year.

In the steel trade there is a fair measure of employment, but the outlook as to the future is not so encouraging as it was some time ago. The question of competition has an important bearing on the market, although less confidence is now felt as to the likelihood of constant supplies of steel of an absolutely trustworthy quality being had from abroad.

The finished iron trade has apparently entered upon a period of comparative slackness. At scarcely any of the malleable ironworks in the Lanarkshire district is there full employment for the workmen. In some cases the services of men have had to be dispensed with, at least temporarily, and there are doubts as to an early recovery of business. The prices of finished iron have this week been reduced 10s. to 15s. per ton.

In the foundries the state of employment is variable, and general engineers are not quite so busy as they could desire.

The state of the coal trade is somewhat remarkable. The demand from abroad is just now anything but satisfactory, but in some of the larger home centres the prices to the domestic consumer are about as high as ever; indeed, instances have been noted in which higher rates are now charged than were current a month or six weeks ago. In other localities, again, prices have been substantially reduced to the home consumer. Manufacturers are obtaining splint coals at 13s. per ton, which is 1s. less than during the past month. The quotations for shipping coals at Glasgow harbour are:—Main coal, 12s.; ell, 13s. to 14s.; steam, 14s.; splint, 14s. to 15s. per ton. The aggregate coal shipments from Scottish ports in the past week were 190,572 tons, against 195,826 in the preceding week, and 200,133 in the corresponding week of last year. There is an impression that coalmasters are keeping up prices beyond what is warranted by the actual circumstances of the trade; but if that be the case, such a proceeding could not last very long. Were the supplies very much out of proportion to the demand, as some allege that they are gradually becoming, it could not be possible to maintain prices at the present comparatively high level.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THERE is a little more activity in the steam coal trade, and full expectation that this will increase, as it usually does, before the holidays begin. The application of the colliers for three days having been granted, it follows that the fortnight before Christmas will be a busy time. This week the pressure for supplies appears to have set in, as indicated by ten cargoes going one day to France, nine another, and twelve the next. Last week Swansea despatched 23,540 tons to France, and 4200 tons patent fuel. Amongst the noticeable cargoes of coal from Cardiff this week have been 5300 tons to Singapore, 7300 to Colombo, 6000 to Aden, 4450 to Odessa, 3300 to Santos, 5000 to Japan, &c., Genoa 7000, and Malta 3000 tons.

As anticipated, the Sliding Scale Committee on Saturday last announced, as a result of the audit of coalowners' books, an advance of 2½ per cent. on and from December 1st. This brings the wages up to 73¾ above the standard of 1879, and indicates to the investigator that the price of coal upon which the advance is based was between 16s. 3·43d. and 16s. 5·14d. It follows from this that even after the slight successive drops of 1s. per ton from 25s. to 19s., the colliers' anticipations of further advances are likely to be realised. Many contracts have been made of late at 20s., but, as an authority observes, the average price is reduced by inferior coals which come upon the market.

It must be noticed that the droop in price is largely due to the enormous output going on. The colliers are working well.

Every day this week has seen a greater degree of business animation on 'Change, Cardiff, without any marked strengthening of prices. Best steam coal has moved from 18s. 6d., and at times touched 20s. in some exceptional cases. Mid-week closing coal prices were as follows:—Best steam, 18s. 6d. to 19s. 6d.; seconds, 17s. to 18s.; drys, 17s. 6d. to 18s. 6d.; best small, 10s. 6d. to 11s.; seconds, 9s. to 10s.; inferior, 8s. to 8s. 6d.; best Monmouthshire, 17s. 9d. to 18s.; seconds, 16s. to 16s. 6d., shipped *vid* Cardiff; best house coal, 21s. to 22s.; No. 3 Rhondda, 17s. 9d. to 18s.; brush, 15s. 6d. to 16s. 6d.; small, 12s. to 12s. 6d.; No. 2 Rhondda, 16s. to 16s. 6d.; through and through, 13s. 6d. to 14s.; small, 8s. to 8s. 9d.

Patent fuel continues in good demand, and shipments—foreign—have been large. Latest prices, 21s. to 22s. Coke continues moderately brisk; though, as in coals, output is large in every district, and rivalry keen, marked efforts being shown in make and quality.

Prices show that a decline in price, corresponding to the fall in coal, has set in. Furnace is now from 25s. to 27s., good foundry 28s. to 32s., and special foundry 36s. Pitwood remains firm at 18s. to 19s., and with sharper weather may be expected to advance.

On 'Change, Swansea, this week it was stated that there was an unreported fall in coal prices, but the price at which business was done remained unknown except to those concerned. Probably it was only a few special transactions. The latest quoted prices are as follows:—Anthracite, 25s. to 26s.; seconds, 21s. to 22s.; best large, 18s. to 19s. 6d.; red vein or similar largo, 15s. to 16s.; rubbly culm, 8s. to 10s.; steam coal, 19s. to 20s.; seconds, 16s. 9d. to 17s. 6d.; bunkers, 14s. to 14s. 6d.; small, 8s. to 9s. 6d.; house coal, 16s. to 17s.

Patent fuel, 18s. to 19s. Coke, 26s. to 34s. Pitwood, 20s.

As a rule the fluctuating prices of coal are taking away investors to other than coal shares, which remain without much alteration. The latest dealings have been in Norths at 6⅜, Internationals at £6 13s. 6d. In railways, Barry has fallen a point, Port Talbot is ⅜ lower, Rhymney 4 per cent. debenture has declined a point, and Rhondda and Swansea Bay debenture a point. Taff Vale ordinary is at 71⅜.

Tenby is following in the wake of other Welsh towns, and is going in for a water scheme. At present it is only in its preliminary stages. The idea is to obtain a supply from the Precelly Mountains, at a cost of £67,000.

The imports of American steel bars to Welsh ports the last few days have been considerable, 2764 tons coming from Philadelphia, and 423 from New York for Newport, and 535 tons from New York to Swansea. The last named was consigned to Burgess and Co.

In the Swansea Valley district, a rumour prevails in steel and tin-plate circles that Welsh Bessemer makers have decided upon reducing their prices so as to "cut out" the Americans, and thus stop the imports of steel bars, though if, as reported, very large contracts have been entered into, these must continue for a time. In tin-plates a more hopeful view is taken. The men have agreed to a 10 per cent. concession at the end of the month, and this, with an increased make of boxes, will tell favourably.

On 'Change, Swansea, this week it was the subject of comment that the staple trade of the district was in as flourishing a state as at any period of the quarter. Cwmbwrla, Cwmfelin, Worcester, Upper Forest, Morriston, Foxhole, Park, Clydach, Cardonnel, and Unysmeudwy had full complement of mills going, Pontardawe eight mills, Duffryn seven, and Beaufort eight. The principal demand is for sheets, taggers, and oil plates. Finishing departments, except at Cwmfelin, Duffryn, Worcester, and Pontardawe, quiet. All the furnaces last week at Wright and Butler's were smelting, four at Upper Forest, and two at Works; and it was reported that there was not a bar in stock at any of the three places. At Landore the one blast furnace is casting regularly. Last week the shipments of tin-plates totalled 61,817 boxes; the make was 51,191 boxes; present stock, 145,362 boxes.

At the large Bessemer works a satisfactory amount of business is being turned out. Rails, bars, sheets, and angles are in demand. Constant consignments of sheet iron are being sent to Bristol from Newport, and this week 650 tons angles to Newcastle.

In finished iron and steel it was reported on 'Change, Swansea, this week that there had been a further fall of nearly 10s. per ton in North Country angles, and ship plates fall into the same category. Tin-bar prices remain. They now compare favourably with those of America. In pig there has been another relapse—in scrap of about 1s. 6d., in Middlesbrough 3s. 6d., and in hematites of 2s. 6d. Market may be regarded as weak.

Some more notable and acceptable reductions are to be noted:—Block tin by about £4 7s. 6d. per ton on the week, copper 10s., spelter a little, and lead 5s. per ton.

Latest prices, Swansea, are as follows:—Pig iron, Glasgow warrants, 67s. 6d. to 67s. 8d. cash; Middlesbrough, No. 3, 60s. 3d., other numbers in proportion. Hematite warrants, 74s. 8d. for mixed numbers. Welsh bars, £8 to £8 5s.; angles at usual extras. Steel sheets, £8 5s. to £8 7s. 6d.; iron, £8 10s. to £8 15s. f.o.t. Steel rails, heavy, £6 to £6 5s.; light, £7 to £7 15s. Bessemer steel: Tin-plate bars, £5 5s.; Siemens best, £5 7s. 6d. Tin plates: Bessemer steel coke, 13s. 6d. to 13s. 9d.; Siemens coke finish, 13s. 9d. to 14s.; ternes, per double box, 28 by 20 C., 20s. 6d., 26s. 6d. to 29s.; big sheets for galvanising, 6ft. by 3ft. by 30 g., per ton, £11 to £11 5s.; finished black plates, £9 15s. to £10 5s. Galvanised sheets, 24 g., £12 10s. to £13 10s. Block tin, £123 15s. to £124. Spelter, £19. Copper, Chili bars, £72 10s. to £73 5s. Lead, £17 2s. 6d. Iron ores:—Tafna, 17s. 6d.; Rubio, 18s. Newport and Cardiff prices are, Tafna, 17s. 6d.; Rubio, 17s. 6d. to 18s.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, November 29th.

ONE of the features of the present booming condition of the stock markets is the progress made toward certain railroad combinations. It is just reported, but not confirmed, that the Pennsylvanian Railroad Company has secured control of the Southern Railway System of 2600 miles along the South Atlantic coast, traversing a rich manufacturing and agricultural region, mainly cotton. Other giant consolidations are under way, and the interests of separate systems are drawing them together. The Southern Pacific, the Atchison, the Northern Pacific, and the Great Northern, are all working out schemes looking to combinations in their respective fields. The new road from Salt Lake to Los Angeles—capital, 25,000,000 dols.—will be built.

Railroad companies and Eastern capitalists are starting to develop a remote region of the West, viz., the five northern counties of Arkansas, fifteen hours by express from St. Louis. The region abounds in zinc and lead, and promises to exceed the Joplin region. The output of the Missouri-Kansas lead-zinc region is increasing rapidly. Price of zinc at mine, 29·50 dols.; lead ore, 46 dols. Production of lead since January 1st, 439,486,930 lb.

The steel situation is stronger, owing to the control of combinations and to the rush of orders for material. Railroads are still halting to obtain better prices than 26 dols. Steel billets have been advanced 3·50 dols. under a combination, which keeps billet manufacture and finished steel manufacture separated. All steel capacity is sold up, and demand is far from satisfied.

The anthracite coal trade is very active, and supplies are inadequate at all points. Prices have been advanced 75 cents per ton. Lake receipts at one western point, Milwaukee, is 300,000 tons less than same time last year.

Figures of the Treasury Bureau of Statistics show an increase in exports for ten months this year over same time last year of 166,000,000 dols. Exports of agricultural products for like period 700,000,000 dols., against 625,000,000 dols.

The remarkably good dividends paid last week by industrial companies have had a favourable influence. The industries are doing well. Great additions and expansions are in prospect, and as there is an abundance of money for investment at low rates of interest, it is reasonable to conclude that no discouragement will be offered to well-considered enterprises. The stock markets are extremely active, and further advances are certain. Earnings of railroads and industrial companies warrant high quotations, but the general public is slow to recognise the strength of the market. Without doubt the States have entered upon a long era of more than ordinary activity. The currency law is to be amended in such a way as to make all forms of money, including greenbacks and silver, redeemable in gold, a step which Congress recommended last winter, but was postponed until after the people had had a chance to speak at the general election.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal market is about the same as last quotations. There has been a better supply of tonnage come on. House coal, owing to the mildness of the season, is quiet. Exports for week ending 1st December were:—Coal, foreign, 51,353 tons; coastwise, 10,992 tons. Imports for week ending 4th December were:—Iron ore, 13,090 tons; pig iron, 195 tons; cement, 271 tons; loam, 675 tons; pitwood, 4512 loads.

Coal: Best steam, 17s. 6d.; seconds, 16s. to 16s. 6d.; house coal best, 19s. to 20s.; dock screenings, 9s. 6d.; colliery small, 8s. 6d. to 8s. 9d. Pig iron: Scotch warrants, 67s. 6d.; hematite warrants, 73s. 6d. f.o.b. Cumberland prompt; Middlesbrough, No. 3, 60s. Iron ore: Rubio, 17s. 6d. to 18s.; Tafna, 17s. 6d. Steel: Rails—heavy sections—£6 to £6 5s.; light ditto, £7 to £7s. 15s.; Bessemer steel tin-plate bars, £5 5s.; Siemens steel tin-plate bars, £3 7s. 6d.; all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 13s. 6d. to 13s. 9d. nominal; Siemens—coke finish—13s. 9d. to 14s. nominal. Pitwood: 19s. to 19s. 6d. ex ship. London Exchange Telegram: Copper, £72 2s. 6d.; Straits tin, £123. Freights easier.

ROYAL INSTITUTION.—A general monthly meeting of the members of the Royal Institution was held on Monday afternoon, the 3rd inst., Sir James Chrichton-Browne, treasurer and vice-president, in the chair. The managers reported that at their meeting held that day they had elected Dr. Allan Macfadyen Fullerian Professor of Physiology for three years, the appointment dating from January 14th, 1901. The following were elected members:—Mr. J. Aungier, Mr. E. Barclay, Mr. R. T. Baylis, Mr. H. P. Boulnois, Mrs. E. Hills, and Mr. R. Taylor

NOTES FROM GERMANY.

(From our own Correspondent.)

THE business in iron and steel is becoming more unsatisfactory every week, consumers being less inclined than ever to place any forward orders, and what they buy for immediate delivery is of small weight. In the railway and engineering departments employment continues lively, and the prospects for future occupation are decidedly bright, but all other branches of the iron trade show a decreasing tone. Malleable iron, which is particularly languid, is reported to have been offered at M. 140 p.t. free Dortmund; bars in basic fetch M. 150 p.t. At a meeting held in Cologne on November 27th, the owners of the steel works in Rheinland-Westphalia, the Saar and Mosel district, and in Luxemburg, agreed to form a billet and girder convention for three years.

In October of present year German production in forge pig and spiegeleisen was 144,655 t., Bessemer 47,685 t., basic 423,254 t., foundry pig 127,126 t.; total production thus amounting on 742,720 t., against 691,266 t. for October last year. In September of present year output of pig iron in Germany was 709,200 t.; from January 1st to October 31st of present year 6,920,934 t. were produced, against 6,719,843 t. for the corresponding period in the year before.

Demand on the Austro-Hungarian iron market continues to quiet down, the tendency in all departments being extremely weak. The reduction of one crown per 100 kilos. for girders has not led to any improvement in inquiry, buyers holding off just as much as ever. The locomotive and wagon shops are fairly well occupied for the present, and they are likely to remain in good activity for the next few months, the Kaiser Ferdinand Nord Bahn having resolved to place orders for 31 locomotives, worth 2·3 million crowns, with inland firms, and there is also talk of a pretty large contract for wagons holding out.

The tone of the Austro-Hungarian coal market is less stiff than formerly, and prices are expected to change in favour of the buyer before long. Only coke remains scarce, and, consequently, extremely firm. House coal from Silesia meets with good demand, quotations being inclined to move downwards.

From the Belgian iron market very unsatisfactory reports come in. The situation of the raw and manufactured iron business continues dull, and prices show further reductions. Bars No. 2 for export are quoted 145f. p.t., while for inland sales the price of 155f. p.t. is maintained. Iron girders stand on 150f. p.t. for foreign, and 155f. p.t. for home consumption. Quotations for plates have been generally well maintained, Siemens-Martin steel plates fetching 190f. to 200f. p.t., and common steel plates 175f. p.t.; for export orders a reduction of about 50 to 75 cents is granted. At a tendering for 227 first and second-class passenger cars for the Belgian State Railways, which took place on November 28th, two German works, the wagon-shops Rastall and the South German wagon-factory in Kelsterbach, offered lowest, and the order, which is worth more than four million francs, was consequently granted them.

The Belgian coal market is not so firm as in the preceding month, and the contracts signed for delivery in February, 1901, all show a decrease of about 2f. p.t.; the collieries in the Hainault may, perhaps, be able to maintain these quotations, but in the Liège and Charleroi district further reductions are sure to take place, as German competition is very keen in these parts. Besides, the convention prices for German coal are lower than the Belgian quotations, and so it seems only natural that heavy lots of German coal are consumed in Belgium. House coal is extremely stiff in quotation. Belgian import in pit coal during the first ten months of present year, is shown by the *Rheinisch Westphalische Zeitung* to have been 610,000 t. —or 30 per cent.—higher than during the same period last year. Import in coke, on the other hand, shows a falling off, 5000 t. less having been imported than last year. Increase in import from the different countries were:—Germany + 160,000 t.; Great Britain + 500,000 t.; Low Countries, + 24,000 t.; and other countries, + 3500 t. Import in French coal to Belgium shows a decrease of 74,000 t. In coke an increase in import is only noticeable from Great Britain—7000 t., while the import from Germany was 9500 t. less, and that from France 4000 tons less than during the same period in the year before. Belgian export in coal and coke shows a considerable increase, French consumption being specially heavy. In coal 600,000 t. more have been exported during the first ten months of present year than in the same period last year, while the increase in export of coke was 76,000 t.; 74 per cent. of the coal exported falls to France, Germany consuming 12,000 t. more; Luxemburg, 68,000 t. more; and the Low Countries, 16,000 t. more than last year. To Great Britain, 23,000 t. less were sent than in the previous year; to Chili, 5000 t.; to Russia, 8500 t., and to Sweden, 4000 t. less than last year, whereas Switzerland consumed 11,000 t. more than in 1899. Export in coke to France was just 60 per cent. of the total Belgian export in that article. For all those countries that are being influenced by the coke convention, an increase in export is noticeable—Germany, 2000 t.; France, 65,000 t.; Luxemburg, 11,000 t. For other countries export was as follows:—United States – 2000 t.; Italy – 9000 t.; Low Countries + 6000 t.; Switzerland + 7000 t.

A poor, irregular business is done on the French iron market. Malleable iron bars have dropped from 280f. to 200f. p.t. last week, although the prices for crude iron, as well as for coal, are as stiff as ever. Foreign offers increase, and as there are very few buyers just now, the result is that the general tone of the market gets more depressed from week to week.

TRADE AND BUSINESS ANNOUNCEMENT.—Orders for the "Archbutt-Deeley" Water Softening Plant have been placed with Mather and Platt, Ltd., by the Electrical Power Distribution Company, for its works at Sutton, and by Albright and Wilson, Limited, Chemical Manufacturers, Birmingham.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

**** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

22nd November, 1900.

21,078. SOLVING PROBLEMS, F. S. Snowdon and J. E. Wieland, London.
21,079. STRIKING MACHINE, O. E. Smith and J. E. Seary, London.
21,080. TAPS for BARRELS, W. R. L. Brindley, Birmingham.
21,081. PRESSES, J. Tonry, Wolverhampton.
21,082. FOLDING BATHS, J. Tonry, Wolverhampton.
21,083. SELF-CLOSING BOXES, J. Tonry, Wolverhampton.
21,084. ACOUSTIC SPEED INDICATORS, E. Gieseler, Manchester.
21,085. STEAM WAGONS, J. H. Mann and Mann's Patent Steam Cart and Wagon Company, Limited, Leeds.
21,086. ELECTRICAL FITTINGS, G. Sperryn and W. H. Wood, Birmingham.
21,087. MANUFACTURE of FORGINGS, W. J. Wright, Stockton-on-Tees.
21,088. DRILLING MACHINERY, D. Smith, Wolverhampton.
21,089. CLIPS for CARRYING ARTICLES, T. Morton, Birmingham.
21,090. ATTACHING BANDS to SKIRTS, R. D. Young and T. Morton, Birmingham.
21,091. DEVICE for TRANSMITTING POWER, A. Bodding, London.
21,092. BRAKES for VELOCIPEDES, J. Parr, Leicester.
21,093. RECEPTACLE for TESTING EGGS, M. Green, Belfast.
21,094. PROPELLING HORSELESS CARRIAGES, T. Gibbs, London.
21,095. FRICTION LEVER, H. Ingham and J. H. Read, Blackburn.
21,096. LOOMS for WEAVING, J. Dickson, Huddersfield.
21,097. MIXING DOUGH, J. Vicars, sen., T. Vicars, and J. Vicars, jun., Liverpool.
21,098. CRANES, E. Hollings and C. W. Mills, Liverpool.
21,099. AIR-PUMPING MACHINES, Z. W. Baugh, Birmingham.
21,100. ELECTRICAL TRANSFORMERS, J. P. Hall, Manchester.
21,101. STEAMING TEXTILE GOODS, W. Mycock, Manchester.
21,102. TAMBOURING MACHINES, J. Köhler, Manchester.
21,103. CARGO PROTECTOR, C. A. Jeffreys, Grays, Essex.
21,104. STOPPER for BOTTLES, W. E. Chamberlain, Exeter.
21,105. APPARATUS for BURNING FUEL, J. J. Kermode, Liverpool.
21,106. BURNING COAL DUST, J. J. Kermode, Liverpool.
21,107. SIGNALLING, E. H. and J. C. Allsopp, West Bridgford, Nottinghamshire.
21,108. CRUSHING TOBACCO STALKS, E. Quester, Manchester.
21,109. MACHINES for CUTTING BOOKS, J. B. Mercer, London.
21,110. BRAKE MECHANISM for CYCLES, F. Easom, London.
21,111. VAPOUR LAMPS and BURNERS, L. Le Marquand, London.
21,112. FIGURES for THROWING GAMES, J. Mason, London.
21,113. FIGURES for THROWING GAMES, J. Mason, London.
21,114. METALLIC SIEVE CLOTHS, M. Kirchner, London.
21,115. HANDLE-BARS for BICYCLES, L. F. C. Rich, London.
21,116. TYPEWRITERS, A. M. Cochrane, London.
21,117. MEANS for SECURING FISH-PLATES, T. B. Place, London.
21,118. BRAKES, A. E. Hall and H. de M. Wellborne, London.
21,119. STOPPERING DEVICE for BOTTLES, W. Wüst, London.
21,120. CARTRIDGES, T. Parker, Eton, Bucks.
21,121. BOTTLING LIQUID, T. Cloke and The Crown Cork Company, Limited, London.
21,122. RAILWAY STATIONS, G. F. Collinson and C. Johnston, London.
21,123. CHANNELS for SINK WATER, C. Flood, London.
21,124. WRITING SLATES, A. Ecker, London.
21,125. CLUMP SOLE for FOOT-WEAR, A. S. Hartrick, London.
21,126. ACTUATING SIGNALS, H. E. A. Cousin and L. J. H. Rochatte, London.
21,127. SIGNALS, H. E. A. Cousin and L. J. H. Rochatte, London.
21,128. FEEDING BAGS for HORSES, G. Daws, Birmingham.
21,129. SAUCEPANS, A. E. Edwards, London.
21,130. PRODUCING BLUE SHADES on WOOL, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
21,131. CARPET HOLDERS, A. E. A. Edwards and W. Shaw, London.
21,132. DRIVING ENDLESS BUCKET CONVEYORS, T. R. Murray, Melksham, Wilts.
21,133. STEAM BOILERS, G. Lentz, London.
21,134. LATHES, H. H. Lake.—(*Aktiebolaget Verktygsmes Kiner, Sweden.*)
21,135. PLATES for SECONDARY BATTERIES, T. Pescatoro and The Tudor Accumulator Company, Limited, London.
21,136. TUNING PIN for PIANOS, &c., O. C. Beale, London.
21,137. COMBS, E. Boyard, Liverpool.
21,138. TABLES, W. J. Thomas, Liverpool.
21,139. LEAD PIPE JOINTS, R. A. Lowe and H. Line, London.
21,140. KNIFE POWDER CANISTER, G. H. Ellis, Northwood, Middlesex.
21,141. JERSEY, A. B. Plowden, London.
21,142. TIRES for WHEELS of VEHICLES, A. I. Rath London.
21,143. FEED-WATER REGULATOR, T. E. Fraser and G. Garbutt, London.
21,144. STARTING ELECTRIC MOTORS, W. Watson and E. Preece, London.
21,145. MOTOR-DRIVING MECHANISMS, H. J. Lawson, London.
21,146. TIRES, G. A. Ryden and W. and C. A. Achtmeyer, London.
21,147. HOT and COLD WATER TAPS, H. J. Quilter, London.
21,148. THE TREATMENT of CARBOYS and BOTTLES, B. J. B. Mills.—(*Société Anonyme des Enduits Archambault, France.*)
21,149. METAL-PRECIPITATING PROCESS, J. Meurant, London.
21,150. APPARATUS for MAKING CARDBOARD, C. K. Graham and The British Uralite Company, Limited, London.
21,151. BOOTS and SHOES, C. M. Hall and H. Goodings, London.
21,152. GAME, A. Steer, W. Edwards, and H. C. Braun, London.
21,153. TREATMENT of YEAST, G. C. Marks.—(*" Force" Société Anonyme, Belgium.*)
21,154. RABBIT BOXES, J. W. Story and W. Burrell, London.
21,155. RENOVATING FADED COLOURS, A. Basch and S. Weis, London.
21,156. HEAT INSULATORS, H. J. Haddan.—(*C. Paris, France.*)
21,157. WEIGHING MACHINES, H. J. Haddan.—(*The Suspension Beam Scale Company, United States.*)

23rd November, 1900.

21,158. UNITING ALUMINIUM, S. Cowper-Coles, London.
21,159. TREATMENT of COMPLEX SULPHIDE ORES, S. Cowper-Coles, London.
21,160. PNEUMATIC TIRE for CYCLES, D. H. Morgan, Cheltenham.
21,161. AIR VALVES for FOOTBALLS, F. S. White, Norwich.
21,162. HOLDING FLORAL WREATHS in POSITION, J. W. Jones, Dorset.
21,163. SPEED GOVERNORS for MOTOR CARS, B. P. Olsson, London.
21,164. COVERS for UMBRELLAS, F. Cowburn, Blackburn.
21,165. ANTI-VIBRATORS for INCANDESCENT LAMPS, A. Crowther, Bradford.
21,166. TROUSER STRETCHER, W. Turnpenney, Bradford.
21,167. SMOKE-CONSUMING APPARATUS, S. Knowles, Manchester.
21,168. HOLDERS for LABELS, J. B. Paton and J. M. Ralston, Barrhead.
21,169. FLOWER POTS, J. B. Paton and J. M. Ralston, Barrhead.
21,170. MANUFACTURE of DENTAL-PLATES, R. Marston, Leicester.
21,171. FASTENINGS for GARMENTS, L. M. Burstall, Liverpool.
21,172. FILTER CLOTH, W. J. Bosley, W. G. Owen, and A. G. Jones, Southampton.
21,173. BRACKETS for CANDLE LIGHTS, J. Jackson, Birmingham.
21,174. WEAVING WARPS, W. H. Crompton and W. Horrocks, Manchestar.
21,175. DAMPERS for TRAVELLING OVENS, D. Thomson, Glasgow.
21,176. SPINNING MACHINERY, E. Merrall, Keighley.
21,177. TOBACCO PIPE LIGHTER, C. S. Wood, Liverpool.
21,178. STEAM GENERATORS, J. Green and G. Howe, Liverpool.
21,179. TELEPHONE SWITCH JACKS, A. Whalley, Helsby, near Warrington.
21,180. ELECTRIC CURRENT INDICATOR, P. J. Pringle, Sidcup, Kent.
21,181. NUMBER PRINTING MACHINES, E. P., R., and E. Greenwood, Manchester.
21,182. GAS PENDANTS, M. F. Hawkes, Birmingham.
21,183. PRINTING MACHINES, F., A., and C. Billing, Birmingham.
21,184. PORTABLE FURNACES, G. Rose, Glasgow.
21,185. DEVICE for STEREOSCOPING, J. C. Manifold, London.
21,186. The SPIRAL ELEVATOR, W. A. Jackson, Manchester.
21,187. CHALK-CUTTING MACHINERY, R. J. Wyatt, Crewkerne, Somerset.
21,188. FLOATS for SAVING LIVES, D. Wuillemin, Glasgow.
21,189. CONTROLLING STORM-WATERS, E. Dodd, Birmingham.
21,190. AUTOMATIC COUPLINGS for CARS, A. Kyle, Hawick.
21,191. TRAMWAY RAILS, C. Hessel and W. Sippel, Manchester.
21,192. WINDOW BLINDS, T. W. and F. C. Tidmarsh, London.
21,193. CHURN, O. Heinrichs, Liverpool.
21,194. WATER-CLOSETS, W. E. and H. E. Mason, Manchester.
21,195. ASSAY FURNACE, D. Laird, Manchester.
21,196. ELECTRIC LIGHT FIXTURES, G. L. Martin, New York, U.S.A.
21,197. CYCLE BRAKES, W. T. Lord, London.
21,198. COMBINATION BATH ATTACHMENT, A. J. Allen, London.
20,199. VELOCIPEDE DRIVING GEAR, W. H. Keeling, Birmingham.
21,200. MOTOR CAR DRIVING CHAINS, C. H. Brampton, Birmingham.
21,201. CONSTRUCTING PORTABLE PIANOS, W. Hutchison, London.
21,202. BOTTLES, J. F. R. Wood, London.
21,203. DIRECT-ACTING STEAM PUMPS, A. Gascoigne, London.
21,204. ENGINE VALVES, C. C. Wardrop and T. S. James, London.
21,205. SCREWS, H. J. Perry, London.
21,206. NUT-LOCK, N. Stafford, London.
21,207. JOURNAL BOXES, A. C. Pessano, London.
21,208. LUG STRAP for LOOM PICKER STICK, G. A. Lyon, London.
21,209. PUMPS, Davey, Paxman, and Co., Limited, and T. S. King, London.
21,210. TEXTILE CALCULATORS, E. Lord, Burnley.
21,211. AUTOMATIC BRAKE for VEHICLES, J. S. Hainsworth, Ilford.
21,212. FASTENING DEVICE for BOXES, W. H. Reddan, London.
21,213. PRODUCING OXYGEN, W. F. B. Massey-Mainwaring and J. Feitelson, London.
21,214. PRODUCING CALCIUM CARBIDE, D. de Vulich and J. d'Orlowsky, London.
21,215. MUSICAL BOXES, H. H. Lake.—(*The Firm B. H. Abrahams, Switzerland.*)
21,216. GRAPHITISING ELECTRODES, P. M. Justice.—(*The International Acheson Graphite Company, United States.*)
21,217. CURRENT REGULATORS, P. M. Justice.—(*The Erie Exploration Company, United States.*)
21,218. TRACTION ENGINES, W. Tasker and Sons, Limited, and W. Brown, London.
21,219. VICES, J. J. Stevens, London.
21,220. MANUFACTURING SPUR ROWELS, J. W. Brooks, Birmingham.
21,221. ROTARY ENGINES and PUMPS, G. Grimes, London.
21,222. PURIFYING PAPER PULP, &c., H. Schmolks, London.
21,223. FASTENING DEVICES for CUFFS, A. A. Storey and E. Ingham, London.
21,224. TOBACCO PIPE, W. B. Haas, London.
21,225. TIME and AUTOGRAPH RECORDERS, R. P. Link, London.
21,226. DRYING EARTHENWARE ARTICLES, A. E. Brown, London.
21,227. REPETITION PIANO ACTIONS, J. W. Darley, jun., London.
21,228. ELECTRODES, The Bastian Meter Company, Limited, and C. O. Bastian, London.
21,229. CONTROLLING WATER BALLAST, W. P. Thompson.—(*G. B. Willcox, United States.*)
21,230. MOTORS, C. Piguet, London.
21,231. APPLIANCES for ASCERTAINING DISTANCES, C. A. Trotter, London.
21,232. CONSTRUCTION of WHEELED VEHICLES, J. Taylor, London.
21,233. SECONDARY BATTERIES, T. Pescatore and The Tudor Accumulator Company, Limited, London.
21,234. WASHING and WRINGING MACHINERY, R. Evans, Liverpool.
21,235. SHIRTS and FRONTS of SAME, J. Hood, Liverpool.
21,236. PROCESS for DYEING WOOL, G. Bethmann, London.
21,237. TYPEWRITING MACHINES, H. Burg, London.
21,238. CONVEYORS or ELEVATORS, W. H. Aston, London.
21,239. PHOTOGRAPHIC CAMERAS, E. S. Shepherd, London.
21,240. BRAKES, J. M. J. Louche, A. Pougy, and C. A. Chabrol, London.
21,241. HEAD COVERINGS for ANIMALS, B. Desouches and A. Herse, London.
21,242. FASTENING STOPPERS in BOTTLES, M. D. Lehmann, London.
21,243. DUST-DESTROYING APPARATUS, L. Bössler, London.
21,244. HARDENING ARMOUR PLATES, Sir A. Wilson, Bart., London.
21,245. MECHANICAL PRIMERS, Sir W. G. Armstrong, Whitworth, and Co., Limited, and G. Stuart, London.
21,246. PLOUGHS, R. H. Fowler and T. Benstead, London.
21,247. VALVES, D. B. Morison, London.
21,248. TRANSFER of LIQUIDS into RECEPTACLES, B. Wilcox.—(*The Compagnie Générale pour la Conservation des liquides, France.*)
21,249. MOTTOE RING GUARD, E. Wade, Maidenhead, Bucks.

24th November, 1900.

21,250. LEVELLING-SCREW DEVICE, W. G. Pye, Cambridge.
21,251. A NEW LEGGING, H. Humphreys, Manchester.
21,252. RAYS for SURGICAL PURPOSES, C. M. Johnson, Redhill, Surrey.
21,253. COVERING SEATS, W. Longfield and C. E. Ward, Hull.
21,254. MITRING or CUTTING MACHINE, W. E. Gay, Bristol.
21,255. JOINING ELECTRIC CONDUCTORS, C. V. de Falbe and T. Harden, London.
21,256. DEFECATOR for CLARIFYING LIQUID, R. Harvey, Glasgow.
21,257. RAILWAY SIGNALS, J. Bryce, Glasgow.
21,258. DISPLAY STAND for GLASSWARE, F. A. Darrah, Manchester.
21,259. COIN-FREED MECHANICAL TOY, W. C. Haigh, Manchester.
21,260. LOOMS for WEAVING, M. Sowden, Halifax.
21,261. CLEANING HORSES, J. Briggs and J. H. Dickinson, Halifax.
21,262. CASES for FILING LETTERS, H. Macaulay, Hamilton, Lanarkshire.
21,263. DRESS FASTENER, C. H. Collins, Birmingham.
21,264. GRATE for ECONOMISING FUEL, E. Taylor, Blackburn.
21,265. FILING DEVICE, A. H. Church, Manchester.
21,266. RIMS and TIRES for VEHICLES, F. R. Booth, Sheffield.
21,267. SYRUP, A. E. Berry and A. Boake, Roberts and Co., Limited, Stratford, Essex.
21,268. NOISELESS SICK-ROOM FIRE-IRONS, I. G. Liller, Dublin.
21,269. SHIRT STUDS, J. Walker, Birmingham.
21,270. UMBRELLA STAND, M. Mendel, Manchester.
21,271. CAN OPENER, A. King, Nottingham.
21,272. FIXING METAL to EARTHENWARE, J. Shanks, Glasgow.
21,273. TRAMCARS, J. Whitehead, Birmingham.
21,274. ATMOSPHERIC GAS BURNERS, S. Timings, Birmingham.
21,275. HEALTHY WINDOW-SASH FASTENER, J. R. Taylor, Bacup, Lancs.
21,276. SANITARY CONNECTIONS, T. Robinson, Wardle, Lancs.
21,277. POTATO DIGGERS, J. Larkin, West Kirby, Cheshire.
21,278. DRIVING MECHANISM, C. Hanrott and H. O. Seyd, London.
21,279. HAND CAMERAS, A. C. Jackson, London.
21,280. AVOIDING FRICTION, W. B. Aubrey, London.
21,281. CIGAR HOLDERS, E. Poitel, London.
21,282. CANT RAIL HINGES, S. and J. Wilkes, Birmingham.
21,283. FLUSHING APPARATUS for WATER-CLOSETS, L. A. Swale, London.
21,284. GAS FIRES, E. T. Whitelow and C. P. Ehmann Manchester.
21,285. SADDLES for CYCLES, C. W. R. Duerre, London.
21,286. CYCLES, A. N. Wight, London.
21,287. ELASTIC PACKING, R. Daelen, London.
21,288. TOBACCO PIPES, A. C. and J. O. Dreymann, London.
21,289. ORNAMENTING GLOBES, C. Hodan and J. Wellings, London.
21,290. SUPPLYING FUEL to BURNERS, F. Wilkinson and T. H. Brough, London.
21,291. PAINTING TABLETS, A. Rinckiake, London.
21,292. OBTAINING MAGNETIC ADHESION, The British Thomson-Houston Company, Limited.—(*The Union Elektricitäts-Gesellschaft, Germany.*)
21,293. ELECTRIC CONDUCTOR, The British Thomson-Houston Company, Limited.—(*C. P. Steinmetz, United States.*)
21,294. ELECTRIC DISTRIBUTION, The British Thomson-Houston Company, Limited.—(*C. P. Steinmetz, United States.*)
21,295. GAS HEATING APPLIANCES, E. C. Harvey, London.
21,296. BOOKBINDING, C. J. Bosanquet, London.
21,297. DETERMINING WEIGHT of GRAIN, J. McGuirk, Liverpool.
21,298. VALVE GEAR for ENGINES, C. Robinson, London.
21,299. FLUID-PRESSURE ENGINES, C. Robinson, London.
21,300. MOULDING SCREW STOPPERS, J. Taylor, London.
21,301. IGNITING DEVICE, L. S. Clarke and J. G. Heaslet, London.
21,302. REFRIGERATING APPARATUS, W. W. Harris, London.
21,303. SHAVING APPARATUS, H. Drösse, London.
21,304. ELECTRIC METERS, F. Lux, London.
21,305. TREATING BUTTER, H. Iscovesco, London.
21,306. MACHINE for CLEANING FLAX, L. H. Schneider, London.
21,307. PNEUMATIC TIRES for CYCLES, W. Emerson, London.
21,308. STANDS for BOTTLES, L. H. Sockeel-Febure, London.
21,309. WEAVING LOOMS, Z. J. J. Destriez and B. Lacroix, London.
21,310. SULPHIDE COLOUR, R. B. Ransford.—(*L. Cassella and Co., Germany.*)
21,311. ELECTRIC TRACTION, H. C. King, London.

26th November, 1900.

21,312. POLEHEADS for VEHICLES, A. M. Young, London.
21,313. STEAM COOKING APPARATUS, F. Shepherd, Bradford.
21,314. PIGMENTS, R. C. Young and J. A. Gardner, Bradford.
21,315. BRAKES, J. Hancock, F. Sudbury, and T. Smith, Nottingham.
21,316. METHODS of HEATING WATER, C. H. Foster, London.
21,317. PNEUMATIC BOOT and SHOE TREE, E. Howe, Windsor.
21,318. PIPE CLEANER, F. R. Middleweek, Crediton, Devonshire.
21,319. REFUSE COLLECTOR, R. Webb, Cirencester.
21,320. PULLING MACHINES for RAGS, H. Knowles, Heckmondwike.
21,321. REVERSIBLE SPEED GEAR, L. G. Moore, Southampton.
21,322. BISCUIT CUTTERS, J. Bryden and A. Brown, Glasgow.
21,323. FOG-SIGNALLING APPARATUS, G. H. Robinson, Derby.
21,324. REGULATING OIL SUPPLY, J. S., R. D., W. D., and H. C. Cundall, Halifax.
21,325. REGULATING OIL SUPPLY, J. S., R. D., W. D., and H. C. Cundall, Halifax.
21,326. HANDLES for CARRYING SCUTTLES, G. Hill, Stourbridge.
21,327. COVER for PROTECTING STEAM PIPES, M. Fryar, Derby.
21,328. TACHOMETERS, W. Chadburn, Liverpool.
21,329. STREET SWEEPER, J. McAllister, D. Wallace, and J. O. Stewart, Glasgow.
21,330. COMBUSTION ENGINES, E., T. H., and L. Gardner, Manchester.
21,331. AXLE-BOX SEAT, C., W. J., L., and E. Smith, Durham.
21,332. SIGNALLING on RAILWAYS, L. M. Becker, Birmingham.
21,333. INFLATOR NOZZLE, H. G. Atkinson, J. Stone, C. N. Milner, and H. Stone, Birmingham.
21,334. BOILER FURNACES, A. W., J. A., and H. N. Bray, Manchester.

21,335. MANUFACTURE of SCOTCH CARPETS, J. Morton, Glasgow.
21,336. JOINTING LEAD and IRON PIPES, T. Moonie, Glasgow.
21,337. FEED-WATER-PURIFYING APPARATUS, O. Müller, Paris.
21,338. ILLUMINATED ADVERTISING DEVICE, L. Connor, Liverpool.
21,339. EXHIBITING MUTOSCOPE PICTURES, H. W. H. Palmer, South Croydon, Surrey.
21,340. ATTACHMENT for FIXING on SQUEEGEE, E. Shields, London.
21,341. VALVE for HATS, S. Johnson, London.
21,342. MOUNTS for LETTER FILES, A. E. Walker, London.
21,343. RACKS for HOLDING SOAP, &c., R. W. Hutton, Liverpool.
21,344. STEP-LADDERS, C. Pfeiffer, London.
21,345. MANUFACTURING ALUMINIUM ALLOY, L. Mach, London.
21,346. SHOW-CARDS for VEILINGS, &c., F. P. Kirk, London.
21,347. DELIVERING COAL, H. W. Miller and M. Graham, London.
21,348. MOVING DRAIN OBSTRUCTIONS, J. Richardson, London.
21,349. HANDLE-BARS for BICYCLES, G. R. Nicholls, London.
21,350. UNHAIRING MACHINE, C. A. Allison.—(*S. Rosenthal, United States.*)
21,351. VELOCIPEDE FRAMES and WHEELS, A. S. Bowley, London.
21,352. TOY, R. Bull, London.
21,353. CONSTRUCTION of HANDCARTS, G. Hutt, London.
21,354. PREVENTING LOSS by THEFT, W. G. Honey, London.
21,355. MASH TUNS for BEER WORT, H. Debeil, London.
21,356. WASHING COLOURING MATTER, T. B. Greenwood, London.
21,357. METAL-COMMINUTING PROCESS, F. W. Bühne, London.
21,358. PLUGS for CIGAR HOLDERS, W. Christian, London.
21,359. PRINTING FLAT SURFACES, C. D. Abel.—(*Gesellschaft für Huber Pressung C. Huber and Co., Germany.*)
21,360. APPLIANCE for GYMNASIUM, E. Nickerson, London.
21,361. VESSEL-PROPELLING APPARATUS, J. S. Watters, London.
21,362. MOULDS for GLASS BOTTLES, L. Grote, London.
21,363. GOLF CLUBS, W. Philpot, London.
21,364. CLEANING WINDOWS, L. Wright, London.
21,365. SULPHONATED ALDEHYDES, G. B. Ellis.—(*Société Chimique des Usines du Rhône anciennement Gillard, P. Monnet, et Cartier, France.*)
21,366. JOINING TELEGRAPH WIRES, R. J. Fawcett, London.
21,367. COLOUR PRINTING PRESS, A. H. Schumann, London.
21,368. SPIRIT RECEPTACLE, E. L. Brun, Liverpool.
21,369. POTATO DIGGER, R. Bryers and J. A. G. Williams, Liverpool.
21,370. HOSE PIPING, G. E. Heyl-Dia, Liverpool.
21,371. HORSE BITS, F. Swales, London.
21,372. BUFFER CASTINGS, R. S. Courtman, London.
21,373. BILLIARD CUES, D. T. Powell, London.
21,374. ELECTRIC INCANDESCENT LAMPS, H. H. Lake.—(*Electrische Glühlampen-Fabrik "Watt" Scharf and Co., Austria.*)
21,375. CYCLOIDAL GEARING, C. H. O. Hamann, London.
21,376. CONCENTRATION of SULPHURIC ACID, J. L. Kessler, London.
21,377. VARIABLE SPEED GEAR for MOTORS, E. Price, London.
21,378. DRIVING VEHICLES, W. Williams, London.
21,379. INVALID CHAIRS, E. Vincent, London.
21,380. VALVE DEVICE, P. C. Wilson, D. W. Bassett, and J. Dring, London.
21,381. VALVE GEAR for ENGINES, J. A. McMullen, London.
21,382. FASTENER for LADIES' HATS, B. von Frantzius, London.
21,383. GARMENT FASTENING DEVICE, M. F. Loving, London.
21,384. RAILWAY TRACK CLEANERS, M. Power, London.
21,385. APPARATUS for DYEING SKINS, J. Soussial, London.
21,386. BAYONETS, D. H. Romfry, London.
21,387. PROTECTING INCANDESCENT MANTLES, A. Kitson, London.
21,388. ROTARY FURNACE, G. G. M. Hardingham.—(*R. Davey, Italy.*)
21,389. HAIR BINDERS, A. Stockinger, London.
21,390. INTERNAL COMBUSTION ENGINE, C. E. Sargent, London.
21,391. GOVERNORS for ENGINES, C. E. Sargent, London.
21,392. GAS ENGINES, C. E. Sargent, London.
21,393. VALVES for ENGINES, C. E. Sargent, London.
21,394. COIN-CONTROLLED METERS, J. A. I. Craig, London.
21,395. ENTRENCHING TOOL, F. S. Peck, London.
21,396. SUPPORT for VEHICLES, A. and E. H. Pulbrook, London.
21,397. MERCERISING COTTON, F. Simons, London.
21,398. LIQUID DELIVERY VALVES, A. D. Curling, London.
21,399. VARIABLE-RESISTANCE CONTACTS, F. G. Sharp, London.
21,400. RIDING BREECHES, W. Foxton, London.
21,401. WIND MOTOR, H. Braby and C. Coutts, London.
21,402. BLINDS, R. G. Covency, London.
21,403. WATER-CLOSET SEATS, C. Stenier and A. Bins, London.
21,404. DRIVING MECHANISM for BICYCLES, A. Rigg and W. I. Thomas, London.

27th November, 1900.

21,405. DISINFECTING BUILDINGS, J. M. Pringle, London.
21,406. GOVERNORS, F. G. Wright, A. M. Coates, and J. A. Fisher, Liverpool.
21,407. BOOT LASTS, A. Cox, Nottingham.
21,408. DRAUGHT EXCLUDER for DOORS, A. Taylor, Manchester.
21,409. CONDUIT for ELECTRIC CONDUCTORS, S. B. Donkin, London.
21,410. BEDSTEAD RAIL KNOBS, W. H. Thomas, Birmingham.
21,411. FEEDING PAPER to MACHINES, F. King and J. Boylan, Bradford.
21,412. SCREWS, J. Lane, King's Heath, Worcestershire.
21,413. LOOMS, J. Mackie, Reading.
21,414. CONTROLLABLE GAS-COOKER, J. H. Walker, Liverpool.
21,415. HOLDER for SACKS, J. Barber, Liverpool.
21,416. OPEN-HEARTH STEEL, T. N. Muller, Saltburn-by-the-Sea.
21,417. CUTTING FUSTIAN PILE FABRICS, J. Wilson and T. H. Burnett, Manchester.
21,418. WATER-COOLING APPARATUS, T. Ledward, London.
21,419. TOBACCO PIPE, R. Bellis, Manchester.
21,420. DRYING TEXTILE PIECE GOODS, J. Charlesworth, Huddersfield.
21,421. PRODUCING POLISHED SURFACES upon METAL STRIPS, S. B. Halcomb, P. MacGregor, and J. Ainley, Sheffield.
21,422. TYPEWRITERS, W. Hunt, Bothwell, N.B.
21,423. CYCLE BRAKE MECHANISM, W. T. Fisher, Coventry.
21,424. ORANGE-TREATING MACHINES, J. Johnstone, Glasgow.
21,425. APPARATUS for PUMPING LIQUIDS, J. Symington, Glasgow.
21,426. FORM of CANDLESTICK SOCKET, C. E. Morris, London.
21,427. SHUTTLE MOTION, W. Fish and W. Worden, Accrington.
21,428. TOY MACHINE GUNS, A. H. Rochford, London.
21,429. DYNAMOMETERS, K. Leverkus, Charlottenburg, Germany.
21,430. WASHING MACHINE, A. M'Millan, Glasgow.
21,431. DRYING and CONDENSING PEAT, G. T. Zohrab, Glasgow.
21,432. DIRECT-ACTING PUMPS, T. Shore, Stoke-on-Trent.
21,433. CHAMBERS for COLD STORAGE, H. C. Smith, Glasgow.
21,434. CLIP FASTENERS, &c., J. T. B. Bennett, Birmingham.
21,435. MOULDS for CASTING FINGER RINGS, W. H. Ford, London.
21,436. LACING DEVICES for BOOTS, L. A. McGrath, London.
21,437. COVERED INKPOT, W. H. Taylor, Birmingham.
21,438. REFLECTORS, W. Youlten, London.
21,439. RACK for DRYING HARNESS, W. H. Godlonton, London.
21,440. BUILDING-BOXES for REPAIRING the MELTING HOLES in CRUCIBLE MELTING FURNACES, G. and R. Welch, Sheffield.
21,441. IMPACT ENGINES, B. B. Carter, London.
21,442. VALVES, T. Weatherby, London.
21,443. TOUCH TYPEWRITING KEYBOARDS, B. P. Tcherkassov, London.
21,444. CORNICE POLES, T. Baxter, London.
21,445. CARD BOXES, G. W. Weaver, London.
21,446. MACHINERY for MOSAIC FLOOR-CLOTH, E. Batten, London.
21,447. ELECTRIC RAILWAYS, The British Thomson-Houston Company, Limited.—(*G. T. Woods, United States.*)
21,448. ELECTRICAL DISTRIBUTION, The British Thomson-Houston Company, Limited. — (*C. P. Steinmetz, United States.*)
21,449. INTERRUPTING DEVICES for ELECTRIC CIRCUITS, The British Thomson-Houston Company, Limited. —(*E. W. Rice, jun., United States.*)
21,450. TRANSFORMING ELECTRIC CURRENTS, The British Thomson-Houston Company, Ltd.—(*J. E. Woodbridge, United States.*)
21,451. APPLYING ADHESIVE MATERIAL, A. H. C. Robinson, London.
21,452. FISH-HOOKS, A. G. H. Beaman, London.
21,453. MACHINE GUN, M. H. Bowman and W. O. Hughes, London.
21,454. FASTENING ENDS of LACES, E. D. Hopcroft, Birmingham.
21,455. MANUFACTURING SHEET METAL, R. G. Wood, London.
21,456. ADVERTISING FRAMES, S. and J. P. Shuttleworth, and W. May, London.
21,457. TELEPHONY and TELEGRAPHY, S. G. Brown, London.
21,458. WATER-CLOSETS, B. J. B. Mills.—(*Bondi and China, Egypt.*)
21,459. CUT-OUTS for ELECTRIC CONDUITS, J. Sachs, London.
21,460. LIGHTNING ARRESTERS for CIRCUIT CUT-OUTS, J. Sachs, London.
21,461. PNEUMATIC TIRES, F. H. Awdry, London.
21,462. ICE-MAKING MACHINERY, W. G. Potter, Birmingham.
21,463. APPLYING BRAKES, F. Witting and J. Bistriteanu, London.
21,464. LEGGINGS, J. Pullman, London.
21,465. WATER-HEATING APPARATUS, J. F. Simmance and J. Abady, London.
21,466. VALVES, J. Powell, London.
21,467. MAKING GELATINE, R. Haddan.—(*E. R. Edson, United States.*)
21,468. OBTAINING OIL from FISH, R. Haddan.—(*E. R. Edson, United States.*)
21,469. RENDERING APPARATUS, R. Haddan.—(*E. R. Edson, United States.*)
21,470. FIRE EXTINGUISHERS, C. R. Harris, London.
21,471. DUST-ABSORBENT MATERIAL, L. Rosenfeld, Liverpool.
21,472. STEAM TURBINES, R. Schulz, Liverpool.
21,473. GRATES, J. P. Dalby, Liverpool.
21,474. GRAIN-TRANSPORTING APPARATUS, G. Jäger, Liverpool.
21,475. BRAKE APPLIANCES, W. H. Rymer, Liverpool.
21,476. GAS ENGINES, G. H. Skinner, London.
21,477. TIRES, J. H. Cooke and J. S. H. Hammond, London.
21,478. ELECTRIC METERS, J. H. Barker and J. A. Ewing, London.
21,479. SCORING ATTACHMENT for ROTARY STRAW-BOARD-CUTTING MACHINE, H. E. Newton.—(*R. G. Nall, New South Wales.*)
21,480. PUMPS, J. T. Bradford and A. R. Gordon, London.
21,481. SINK STRAINER, E. Tuttle, London.
21,482. MOTOR VEHICLE COUPLING, G. Klingenberg, London.
21,483. BRICKS, W. S. Rawson and R. D. Littlefield, London.
21,484. CELLULOSE COMPOUNDS, O. Imray. — (*J. Bonavita and E. G. P. Thomas, France.*)
21,485. REMOVING ASHES from FURNACES, D. Campbell, London.
21,486. REMOVING CLAMPING RINGS from INCANDESCENT LAMP HOLDERS, H. F. and A. T. Cotton, and A. H. Reddell, London.
21,487. TREATING CHICORY ROOT, J. D. Morel, London.
21,488. VALVE GEAR for PUMPS, Davy Bros., Limited, and E. Crowe, London.
21,489. MACHINE for POUNCING HATS, C. H. Reid, London.
21,490. SWITCHES for ELECTRIC CIRCUITS, R. Lehnhoff, London.
21,491. SPINNING MULES, F. H. Rollka, London.
21,492. HAIR FRAMES or PADS, G. and H. Lichtenfeld, London.
21,493. TIME FUSES for ORDNANCE, Sir W. G. Armstrong, Whitworth, and Co., Limited, Sir A. Noble, K.C.B., and G. Stewart, London.
21,494. SATURATING LIQUIDS with GASES, F. Fischer and L. Kiefer, London.
21,495. COIN-FREED APPARATUS for EXHIBITING PICTURES, E. A. Reeves, London.
21,496. REFRACTORY MATERIALS, R. J. Friswell and The British Uralite Company, Limited, London.

28th November, 1900.

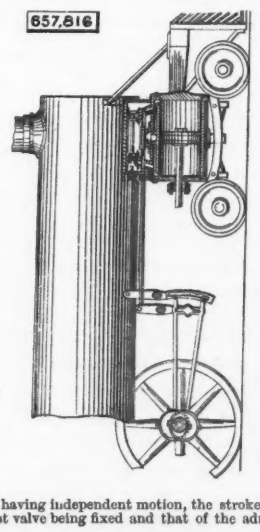
21,497. TREATING METALLIFEROUS ORES, G. Harrison, London.—(*A. C. Lorenz, United States.*)
21,498. LOCKING NUTS, E. W. Pughes and E. Williams, London.
21,499. HOLDING LAMPS, J. Morgan, Hollybush, near Tredegar, Mon.
21,500. DETECTING TIRE PUNCTURES, C. J. Croft and F. E. Dannell, London.
21,501. ELECTRICAL SWITCHES, A. Watson, Birmingham.
21,502. SPANNERS and BOLT HOLDERS, J. W. Martin, Nottingham.
21,503. COUPLING RAILWAY VEHICLES, J. Darling, Glasgow.
21,504. METAL PLATES for ROOFING, K. Beresford, London.
21,505. BREAD-TOASTING DEVICE, O. Eastwood, Elland, Yorks.
21,506. HAND BORING MACHINE, R. D. Harris, Seven Sisters, near Neath.
21,507. VENTILATING BUILDINGS, E. K. Dutton, Harrogate.
21,508. STEAM-TIGHT METALLIC PISTON RINGS, E. Waring, Sheffield.
21,509. FASTENINGS for STAIR RODS, A. Smith, Wolverhampton.
21,510. METAL BOATS, W. Mitchell, A. G. McCrae, and W. Hanson, Glasgow.
21,511. GENERATING ACETYLENE GAS, T. Rauthmell, Stockton-on-Tees.
21,512. TOOL HOLDER for TURNING LATHES, G. V. Ganu, Glasgow.
21,513. TROUSERS PRESS, W. Wall, Bradford.
21,514. FIRE-BAR for FURNACES, T. Westerby and W. G. Crosthwaite, Leeds.
21,515. METAL FENCING, R. R. Main, Glasgow.
21,516. UMBRELLA COVER, A. Mokaiesh and A. Aboushar, London.
21,517. ELECTRIC BELLS, O. Reinicke, Berlin.
21,518. AUTOMATIC CARBURETTING APPARATUS, W. T. Purves and the Notkin Syndicate, Limited, Edinburgh.
21,519. AUTOMATIC CARBURETTERS, W. T. Purves and the Notkin Syndicate, Limited, Edinburgh.
21,520. WATER-TUBE BOILER, J. E. H. Bannister, Southsea, Hants.
21,521. WEAVING COTTON CORDS, F. Arrowsmith, Manchester.
21,522. COLLAPSIBLE SHIPS' BERTHS, A. H. Baird, Liverpool.
21,523. COLLAPSIBLE SHIPS' BERTHS, A. H. Baird, Liverpool.
21,524. CUTTING IRON BARS, H. Smith, H. Smith, jun., and O. Smith, Glasgow.
21,525. AUTOMATIC MIRROR WEIGHING MACHINE, K. Beresford, London.
21,526. SHARPENERS for PENCILS, H. Stuttard, London.
21,527. METHOD of GLAZING GREENHOUSES, J. Allen, London.
21,528. STEAMERS, A. E. Jones, London.
21,529. SHIELD for the TEATS of FEEDING BOTTLES, M. Arnour, London.
21,530. SPANNERS, S. O. Hands, F. J. Holder, and T. Thomas, London.
21,531. DOG SPIKE for FASTENING RAILS, C. E. Bradbury, Paisley.
21,532. REMOVAL of FOULING from SHIPS' BOTTOMS, W. Heatley, London.
21,533. ELECTROLITICAL APPARATUS, J. Matthews and W. Davies, Birmingham.
21,534. PREVENTING MOISTURE on WINDOWS, D. W. Jeffery, London.
21,535. PORTABLE EFFERVESCING BEVERAGES, S. Brown, London.
21,536. CYCLE HANDLE BARS, H. Davey and R. Fleming, London.
21,537. PHOTOGRAPHIC APPARATUS, A. Salmon, London.
21,538. PLATES for ELECTRIC BATTERIES, A. J. Boult. —(*W. J. Jackson, United States.*)
21,539. TURBINES, H. T. Ashton, London.
21,540. OVERHEAD TROLLEY WIRES, A. W. Hancock, J. Leighton, and R. Hacking, London.
21,541. PREVENTING FRAUDULENT RE-FILLING of BOTTLES, S. Richards, London.
21,542. POWER DYEING MACHINES for YARNS, E. Preston, London.
21,543. ATTACHMENTS for PIANOFORTES, H. S. Halford, London.
21,544. PROCESS for HARDENING WOOD, A. M. Effendi, London.
21,545. CINEMATOGRAPHS, L. Gaumont, London.
21,546. RAILWAY AUTOMATIC COUPLINGS, L. Boirault, London.
21,547. WIRE STRIPS, T. E. Sanders, London.
21,548. WROUGHT IRON COLUMNS, W. H. Aston London.
21,549. SOAP SAVER, E. L. Lewis, London.
21,550. EXPLOSION ENGINES, A. G. New and The Electric Motive Power Company, Limited, London.
21,551. COUPLING RAILWAY VEHICLES, A. H. C. Burrow, London.
21,552. STEEL, A. J. Boult.—(*E. Goldschmid, Germany.*)
21,553. PROTECTIVE COATINGS of PAINTS, F. Gerhardt, London.
21,554. SHAVING BRUSHES, F. Gordon, London.
21,555. TOOL, J. A. Schmidt, London.
21,556. SUPPORTING POWER-DRIVEN SEWING MACHINES, C. B. Hunt, H. F. Ainley, and W. F. Fair, London.
21,557. PRODUCTION of FLUORINE, M. Meslans, Liverpool.
21,558. DEVICE for DRAPING CURTAINS, E. M. Lucas, Birmingham.
21,559. FIREPROOF BRICKS for WALLS, C. G. Picking, London.
21,560. PRODUCTION of ANHYDRIDES, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
21,561. DATE and TIME-PRINTING STAMP, R. P. Link, London.
21,562. MONEY TILLS, S. C. Anderson, London.
21,563. METHOD of AERATING LIQUIDS, W. Lawrence, London.
21,564. HORIZONTAL MOTOR CASINGS, G. Klingenberg, London.
21,565. PRODUCING LIQUID under PRESSURE, A. Vogt and M. von Recklinghausen, London.
21,566. SECONDARY BATTERIES, C. A. von Welsbach, London.
21,567. APPARATUS for DRYING GRAIN, J. H. Robinson, London.
21,568. GAS and LIQUID MIXING APPARATUS, A. Martini, London.
21,569. TOBACCO POUCHES, H. T. Roberts, London.
21,570. COIN-FREED MACHINES, C. West and H. C. Braun, London.
21,571. CONCENTRATING in VACUO, J. B. Alliott and J. McC. C. Paton, London.
21,572. APPLIANCES for SEXTANTS, H. A. Gadsen, London.
21,573. NUTCRACKER, H. E. L. Peters, London.
21,574. PICK, H. Davies, London.
21,575. ELECIBIC TELEGRAPHS, A. Muirhead, London.

SELECTED AMERICAN PATENTS.

From the United States Patent office Official Gazette.

657,816. VALVE GEAR for LOCOMOTIVE ENGINES, *G. B. Eddy, Camden, N.J.—Filed April 28th, 1900.*

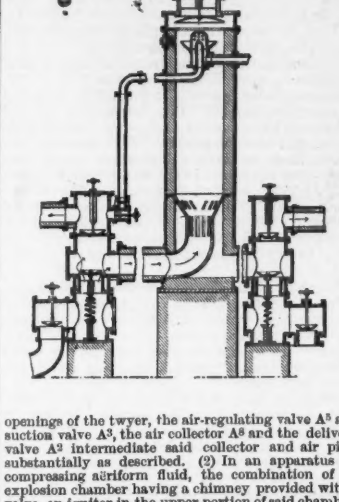
Claim.—(1) An engine having admission and exhaust



valves having independent motion, the stroke of the exhaust valve being fixed and that of the admission valve variable, an excentric mechanism, a link motion actuated by said excentric mechanism, and controlling said admission valve, and mechanism for operating the exhaust valve from the excentric mechanism to impart a full stroke to the exhaust valve irrespective of the position of the said excentric mechanism. (2) A valve mechanism consisting of two excentrics, excentric rods connected thereto by straps, a link to which said rods are pivoted, said link operating upon a block, for transmitting a variable motion to the admission valves, hooks carried by the excentric rods, and means for transmitting a given motion from either excentric from the hooks to the exhaust valve, substantially as described.

657,868. APPARATUS for USE in COMPRESSING AIR and GAS, *E. Gobbe, Jumet, Belgium.—Filed December 27th, 1899.*

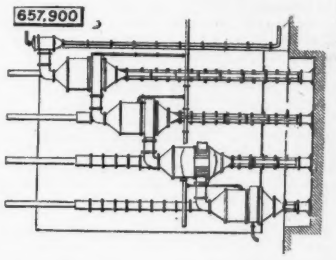
Claim.—(1) In an apparatus for compressing aëriform fluids, the combination of an explosion chamber having a chimney provided with a valve, an igniter in the upper portion of said chamber, a twyer located in the lower portion of the explosion chamber and provided with lateral openings, a valved gas pipe communicating with said twyer, the air pipe A' communicating with the explosion chamber through the lateral



openings of the twyer, the air-regulating valve A^5 and suction valve A^3, the air collector A^8 and the delivery valve A^2 intermediate said collector and air pipe, substantially as described. (2) In an apparatus for compressing aëriform fluid, the combination of an explosion chamber having a chimney provided with a valve, an igniter in the upper portion of said chamber, a twyer located in the lower portion of the explosion chamber, the air pipe A' having valves A^2, A^3, and A^5, the air collector A^8, the gas pipe G' having valves G^2, G^3, and G^5, and the gas collector G^8, the said air and gas pipes being in communication with the explosion chamber through the twyer, substantially as described.

657,900. MULTIPLE-EFFECT EVAPORATING APPARATUS, *E. J. Duff, Liverpool, England.—Filed February 13th, 1900.*

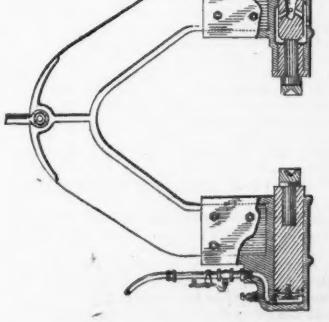
Claim. — A multiple-effect brine evaporating apparatus, comprising a number of separate and independent vacuum pans arranged side by side in



ascending series, each pan being provided with a heating chamber and having at its top a horizontal outlet neck, and the neck of each pan communicating directly with the heating chamber of the next higher pan in the series, as and for the purpose set forth.

657,904. RIVETING MACHINE, *C. H. Johnson, Springfield, Ill.—Filed December 15th, 1897.*

Claim.—(1) In a portable riveter, the combination of a bifurcated yoke, one end of which has a fluid-pressure cylinder in which a clamping piston is reciprocatingly mounted, and the other end with a cylinder having a percussion hammer arranged therein and a die interposed between the hammer and the rivet to be oper-



ated on and held in position by the percussion hammer cylinder, substantially as described. (2) In a pneumatic riveter, the combination with a yoke of a hold-on having a rivet die, a pneumatic hammer, comprising a hammer cylinder and a hammer piston, a rivet die supported by the cylinder of the hammer piston, and fluid-pressure means for causing the said hammer and hold-on to automatically clamp and hold the rivet between the rivet dies during the operation of the pneumatic hammer.

INCREASE OF THE FRENCH NAVY.

The project of the Government for augmenting the war fleet, as approved by the Chamber of Deputies in July, last week came up for discussion before the Senate, and as, meanwhile, opinions have undergone some modification as to the expediency of increasing the navy on the lines indicated, the debate now pending promises to be of some interest. It will be remembered that the project provides for three things—the defence of the colonies, the equipment of the ports and the creation of naval bases, and the augmentation of the fleet. It is the last part of the proposal which is just now occupying the attention of the Senate. The reporter, M. Godin, who examined the project on behalf of the Commission of the Marine, approves of its adoption as amended by the Chamber, that is to say, with an increase of 50,000,000f. for the construction of torpedo boats and submarine boats, and a reduction of one year in the time originally fixed for the execution of the programme, which was to have been completed in 1907. M. Godin gives some statistics as to the productive capabilities of the arsenals, from which he concludes that the country is well able to build the six battleships, five cruisers, and 28 destroyers demanded in six years, and still have plenty of time for the construction of torpedo boats and submarine vessels. Excluding the amount provided for the present year, the sum to be spread over the six years would be 658,350,000f., which would augment the amount to be spent annually by 7,000,000f.

In the opening discussion upon the project it soon became evident that there was still a great diversity of opinion as to what was to be the future strategical importance of the fleet, that is to say, whether the navy is to be constituted to carry on war on generally accepted lines, or whether it is to be built to fulfil the conditions required by the strategy of the new school. So far as the debate has gone, the Senators do not seem to have any great confidence in the value of battleships as a means of attack and defence; but M. Combes, who introduced the discussion, said that he would accept the project because it had been drawn up by the Commission of the Marine, which, being a technical body, was better able to judge of the requirements of the French navy than the members of the Senate themselves. Nevertheless, the Senators are very uneasy as to what will be the outcome of this competition between France and England in the construction of battleships. With each increase in battleships put down on French stocks England replies by doubling the number, and, what is more, she will complete, say, four battleships in less time than it takes France to build two. Thus each year puts our neighbours in a state of inferiority, and by the time the programme is terminated the Senators believe that France will be in a much less satisfactory position to carry on war with England than she is now. With the twenty-eight battleships it is proposed to create four squadrons, two in the Mediterranean, one in the Channel, and one in the North Sea. This arrangement obviously lays France open to some danger, as England can bring a much larger number of battleships against any one of these squadrons without weakening her defences in any way at other points. The French strategist, of course, assumes that it will be possible so far to subdivide the English fleet by means of diversions and attacks by armoured cruisers that the squadrons will be able to fight battles on fairly equal terms, and this brings us to the question of armoured cruisers, which, according to the new school, should dominate the whole of the French naval policy. The advocates of the cruiser argue that nothing definite could ever result from a fight between squadron battleships. In these days of quick-firing guns and high explosives the victorious battleships would probably be as severely handled as the vanquished. Supposing the French to be beaten in the first battle, it would be quite impossible to reconstruct the squadrons, and should they be victorious they would still have to find refuge in the ports for repairs, where they would be useless for the time, while England could bring out fresh squadrons. This is brought forward as a powerful argument in favour of armoured cruisers. But, excluding the cruisers constructed more than twenty-four years ago, the number of vessels of this type owned by France in 1907 will not be more than twenty-three or twenty-four, and these will have to perform such a variety of functions that they will be quite insufficient to play any specially active part in naval strategy. According to Admiral Dupetit-Thouars, each battleship requires an armoured cruiser, a small cruiser, a vessel to serve as a scout, and two torpedo boats. Besides this, they are required for the protection of colonies in distant seas and also to be used as commerce destroyers.

This question of war on commerce has become quite a craze with amateur naval critics in France. The objection that such a war is prohibited by international convention, and that even, supposing the French should violate these laws, it would still be exceedingly difficult, if not impossible, to destroy the commerce of a belligerent country, does not damp the ardour of these specialists in developing their programme. The statement that English owners of merchant ships could cover their cargoes with a neutral flag is regarded as not deserving serious consideration. Since the commerce destroyer is still regarded as a leading factor in French naval strategy, the Senators, who have so far spoken on the subject, have naturally discussed whether the armoured cruisers would be capable of doing this work. M. Combes, however, believes that there are only three new armoured cruisers, the Château-Renault, Guichen, and Jurien-de-la-Gravière, which have sufficient speed and range of action to enable them to capture merchant vessels. Again, these qualities are of vital importance in a war of this description, since, if the cruisers cannot carry on operations at a distance, not only would the English merchant fleet be safe, but the French mercantile vessels would have to remain in the ports, so that more harm would be done to French trade than to the English. Consequently, this brings us to a new development in the French programme. As the Senate and the Chamber seem disposed to let the Government continue the construction of battleships, which will necessarily have to be accompanied by cruisers, the members who have so far taken part in the debate advocate the construction of a special fleet of armoured cruisers composed of, say, fifteen or twenty vessels built for speed, and with considerable coal-carrying capacity, for sweeping the high seas in search of merchant ships. The debate has not yet gone far enough to show whether the Government is disposed to engraft this new feature on their programme, but we do not believe that it will meet with much approval from the Commission of the Marine, who seem to recognise fully the difficulties of attacking the mercantile marine.

Every fresh means of defence suggests a new method of attack, and this is observable in the present discussion on the Government programme. In whatever light the French regard a naval war in the future, they see that England must still preserve her supremacy by reason of her great superiority in numbers. They have nothing to gain from a fight between battleships, though General Mercier has been good enough to say that, if the experience of the land forces in the Transvaal can be taken as a criterion, the personal element of the British Navy may not, after all, be equal to its reputation, since he assumes that quality has been sacrificed to quantity, by the difficulty of maintaining a high standard when the rapid development of the fleet does not allow of such a rigid selection in the officers and crew. Nevertheless, he still supposes that numbers will prevail; so that it is necessary to arrive at some other means of bringing England to reason in any future conflict. General Mercier therefore suggests that, if France is unable successfully to defend herself against overwhelming odds, she should avail herself of the advantages of unexpected attacks by assaulting her powerful neighbour when she least expects it. In this way, says the Nationalist Senator, England would be so utterly demoralised by the first blow that she would not recover quickly enough to carry war into the enemy's camp. This, of course, is an old plan, dating from the first Napoleon, and was elaborated some years ago by General La Rocque, who proposed an invasion of Ireland by means of light transports or pinnaces. With 1500 boats they could carry 170,000 men, and supposing that 10,000 of this number were killed by the enemy's cruisers, the landing force would still be big enough to have things their own way. General Mercier has gone still further. He openly confesses that in 1897 he drew up a plan which he submitted to the Minister of War and the President of the Republic for invading England by means of a fleet of small boats of special construction. Some time ago plans for such boats were drawn up. They were to have a length of 150 metres, a beam of 18 metres, and would have a displacement of 4500 tons. Each would be propelled by engines of 4000 horse-power, and would carry 4500 men. It would draw very little water and would have a low freeboard, so that while it would offer a very small mark to the enemy, it could be beached in shallow water to facilitate the landing of the troops. General Mercier is so confident of the value of what he calls his "offensive strategy" that he proposed a resolution inviting the Government to make all the necessary arrangements so as to allow of an invading force embarking and landing as rapidly as possible. This proposition could not be put, but it clearly shows that attempts at invasion must be regarded as one of the possibilities of warfare in the future, though we do not think that in these days of electric telegraph and other means of rapid communication the landing of a hostile force on these shores would be such an easy matter as the French profess to believe.

The avowal of General Mercier was strongly deprecated by his colleagues, who hastened to do what they could to remove any unfavourable impression that might be created in England by the mischievous utterances of the Nationalist Senator. The Minister of Marine pointed out the absurdity of trying to effect a landing with a flotilla of small boats unless they could prevail upon the enemy's cruisers to do nothing to interfere with the operation, or unless they had a strong squadron of battleships that would keep a hostile fleet at a distance. For the same reason the attacks on commerce present the same difficulties unless the cruisers are backed up by battleships. An enemy can do two things, either keep the cruisers from leaving the ports, or allow them to pass the line-of-battle ships and then prevent their return. In the latter case they would run out of coal and be at the mercy of the enemy. M. de Lanessan, however, is by no means opposed to commerce destroyers, but they can only prove effective when France is able to obtain the mastery of her own waters. Thus we come back to the Government's plea for more battleships. The minister will not admit that there is any immediate necessity for new cruisers beyond those provided by the programme. M. Combes had stated that after excluding the vessels outclassed by age, they would have in 1907 twenty-three or twenty-four armoured cruisers, but M. Lanessan is of opinion that some of the old vessels would still be serviceable in war time, so that there will be actually twenty-eight, which number is more than that possessed by any other marine. While the navy is strong in cruisers, the minister urges that the numerical strength in battleships is by no means so inferior to that of the British marine as is represented. In the construction of their battleships the French are consistently striving after a maximum of offence and defence—in other words, they are ready to sacrifice speed and coal-carrying capacity up to a certain point in order to get the heaviest artillery and the thickest armour, their policy being to carry artillery which will be superior to the defence of an opposing battleship, and have armour at the water-line of a thickness about equal to the calibre of the heaviest foreign guns. Having settled upon the weight, displacement, and beam necessary to arrive at these results, they endeavour to get the best speed they can without sacrificing, in too great a measure, the range of action. It is becoming evident that the sailors are attaching much less importance to the speed of battleships than they did formerly, and in this they have been influenced by the recent experience of the battleship Redoutable and the cruiser Chasseloup-Laubat. When Admiral Pottier was sent to China he hoisted his flag on the Redoutable, but as, owing to her large displacement, it was feared that the battleship would have some difficulty in traversing the Suez Canal, she was accompanied by the Chasseloup-Laubat. On passing the canal the Admiral decided to save time by continuing his voyage in the cruiser, and the vessel was driven at full speed to Saigon, where she arrived some time before the battleship, but the engine-room staff and the firemen were so utterly exhausted that the cruiser had to lay up three or four days. Admiral Pottier continued his journey in the Redoutable, which reached the Chinese waters before the cruiser. These considerations have induced the Government to fix upon their new type of 14,865-ton battleships as representing the maximum of efficiency both for attack and defence, while the speed is expected to reach a limit which cannot be surpassed in such vessels without putting excessive work on the engines or consuming too much coal. Having regard to these qualities, the French naval experts argue that, unit for unit, the French battleship is superior to the British, since, in the eighteen new battleships either afloat or under construction in this country, the weight, and therefore the armour, is sacrificed for speed, and M. de Lanessan informed the Senate that the French armoured cruiser would be an equal match for one of the new British battleships. This may, of course, merely have been intended to produce a rhetorical effect, but it is none the less true that our neighbours are firmly convinced that, taking them singly, the cruiser, on account of its armament, and the battleship, because of its thorough protection, are better than any corresponding type in the British Navy. We are, of course, not likely to quarrel with our neighbours over a comparison which depends upon the point of view from which it is regarded. They are satisfied with at length having fixed upon a definite and logical programme, though the debate clearly showed that it does not entirely fall in with the views of those who have theories of their own. M. Combes, for instance, strongly insisted upon the necessity of building fifteen or sixteen cruisers of the Dupuy de Lôme class to act as commerce destroyers, but the Government could not accept this new addition to their programme because they have already gone up to the limit prescribed by the resources of the budget, though an amendment was adopted inviting the Government to consider the advisability of presenting a project to the Parliament for the construction of these swift cruisers at an early date. It is probable, therefore, that long before the present programme is terminated it will be augmented by the addition of a certain number of powerful cruisers, but at the moment the Government can only guarantee the carrying out of the programme in its present form, and it was for this reason that the sum voted by the Chamber of Deputies was confirmed by the Senate.

ACETYLENE IN GERMANY.

A distinctly able report on the calcium carbide and acetylene industries in Germany, written by Dr. Rose, her Majesty's Consul at Stuttgart, has recently been issued by the Foreign-office; and although most of the information it contains has already been published in our columns, the report should be studied carefully by all persons interested in this branch of trade. Every actual and possible use of carbide, from the reduction of ores to the generation of power, is sketched; and the merits of acetylene as an illuminant in comparison with paraffin, coal gas, and electricity, are discussed in a perfectly dispassionate fashion by an author who evidently understands his subject from the technical as well as the commercial aspect. Calculated in terms of illuminating power, the consumption of petroleum in Germany is said to be three times as great as that of coal gas; and for obvious reasons it is petroleum with which acetylene primarily competes. As in Great Britain so in Germany, paraffin is mainly an imported substance, whereas calcium carbide is principally manufactured on the spot; therefore every triumph of acetylene over petroleum is of great advantage to the country. As do various other writers, Dr. Rose calls attention to the fallacy underlying the erection of carbide works in impossible situations simply because of the existence of cheap water power; the cost of carrying coke to the factories and carbide to the markets are matters of equal, if not greater, importance. It would seem, indeed, as if several continental capitalists have overlooked this point in the past; they have forgotten that it is useless to seek a waterfall where they may save, say, 1s. per horse-power-year in their energy bill, which, theoretically, corresponds to about 1s. per ton on the cost of the carbide, if by so doing they are compelled to pay a railway company on an average 4d. or 5d. per ton more for bringing them their 1¼ tons of raw material and for taking away their 1 ton of finished carbide. For these reasons most large acetylene installations will be found either in the vicinity of a carbide works, or in places where carbide can be delivered at an economical rate. Dr. Rose describes the progress which has been made in utilising waste blast furnace gases for the manufacture of calcium carbide—a matter we dealt with on a recent occasion; and although he mentions the present "crisis" in the carbide trade, he rightly considers it to be of little moment. The industry is only three or four years old, and it has hardly yet settled down to steady work. At first nobody believed in acetylene; nobody cared to provide money to erect carbide works, and the material accordingly could scarcely be procured. Afterwards people believed too much in acetylene; carbide factories were started rapidly in all directions and with insufficient capital, and when better equipped works began to sell, the supply exceeded the demand, the price

fell, the smaller factories were hard pressed, and some have had to retire. The "crisis" is only temporary. The use of acetylene is spreading, and spreading more regularly, and now it is becoming more possible to adjust the dimensions of the two branches of the business in such a way that the carbide maker shall have a fair profit, and the acetylene consumer be certain of an uninterrupted supply.

Dr. Rose gives a good account and explanation of the manner in which village acetylene installations have succeeded in Germany in spite of many pessimistic prophecies. He mentions the lower capital outlay, the smaller operating costs. As the distillation of coal is a comparatively slow process, a village coal gas holder must have a capacity of at least 70 per cent. of the maximum daily consumption; evolution of acetylene being almost instantaneous, an acetylene holder need only be capable of storing 20 or 30 per cent. of the daily demand. Not only so; per unit of light the daily consumption of acetylene is smaller than that of coal gas, ranging between half and one-fifteenth of the latter, according to the proportion of incandescent gas burners employed. Thus the holder needed to cope with the requirements of a given village is reduced very considerably in size by adopting acetylene; and the holder is one of the most expensive items of a gas plant. Dr. Rose hints, no doubt correctly, at another reason why these village or large institution acetylene plants have given more uniform satisfaction than small domestic or portable generators. The former require more capital to erect, and so they have been undertaken only by large firms who are able and willing to employ men skilled in the theory and practice of using acetylene; the amateur mechanic, who ignores chemistry and physics, has had to content himself—though not always his customers—with building small single apparatus. It is a satisfaction, albeit a melancholy one, to learn that the incompetent workman has been a nuisance in Germany, and that he has done temporary harm to the industry also in a country which we are frequently told to regard as our pattern in all things scientific. But it is not altogether satisfactory to see that in Germany an energetic warfare is being urged against the jack-of-all-trades by a strong society of carbide makers and acetylene engineers, which has almost driven him from the field, while here he is left to die a peaceful and lingering death of natural causes alone. In Germany, too, there are four special journals published regularly which deal with acetylene matters, and they are edited by men of standing in the acetylene world; they print important original articles both of a theoretical and a practical character; their opinions seem to be free from bias, and they must carry weight and spread correct information. In England the best writing on acetylene and kindred subjects is to be found in journals appealing to a wider *clientèle*, in which acetylene is but a "side line," and which cannot afford the space to record every little advance made by the industry, or to reiterate times without number the fundamental elementary principles forgotten by the amateur mechanic.

Of course, acetylene is still a far less important factor in everyday life with us than it is on the Continent; in comparison with Germany the trade lacks a most valuable class of customers. Dr. Rose calculates by an admittedly too favourable estimate that the twenty odd German villages may consume some 2000 tons of carbide per annum; but the German railways are taking 8000 tons a year to manufacture their acetylene oil gas. In Bavaria not only are the railway carriages lighted with the mixed gas, but the country stations are being fitted with pure acetylene plants. In England there are at the most three or four railway stations similarly illuminated. Why? The price of paraffin tends to rise here as well as abroad; English roadside stations are often lighted in a style that contrasts unfavourably with a London omnibus. Yet there are plenty of efficient and cheap fixed acetylene generators on the market, and more than one type of reasonably good portable lamp or combined generator and wall lantern. None of these requires so much attention as is necessary to keep a battery of oil or paraffin lamps in good condition; and they all yield a much better light. We do not suggest that acetylene should be installed in localities where incandescent coal gas or electricity is available, but we do urge its employment and its advantages over paraffin. In his recent book, Professor Lewes has done us the favour of quoting largely and adopting the figures we gave in an article (The Engineer, March 31st, 1899) on the relative merits of acetylene and paraffin; but he might fairly have added that conditions have altered somewhat since that calculation was made. We claimed that acetylene was superior to paraffin in everything but cost, in directions which are more important than cost; but we admitted paraffin to be distinctly the cheaper light of the two. Taking the German price of petroleum at 25 pf. per litre (13·6d. per gallon), and of carbide at 32 pf. per kilogramme (1·7d. per pound), Dr. Rose represents the two illuminants to be pecuniarily equal per unit of light. The data are not valid for England, and acetylene is still more expensive; nevertheless, paraffin has a distinct upward tendency, carbide perhaps a slightly downward one, and a day may come when the two competitors shall meet on equal terms. Paraffin can be rendered more economical from the luminous point of view by burning it under a mantle; but so can acetylene. The great advantage of the former is that it yields a light bright enough for all purposes without the necessity of adopting the incandescent system, which is still handicapped by many minor troubles and expenses.

Taken as a whole, Dr. Rose's report is a most valuable contribution to the literature of acetylene, since it is naturally free from prejudice. English readers must, however, remember that it deals only with one country, and similar accounts of progress might be given of France, Austria-Hungary, and the United States. We should be glad to receive reports from our consuls in some of these places, to show how the use of acetylene is spreading, and how the exportation of carbide is increasing; for although Great Britain is a land unprovided with waterfalls, we have blast furnace gases, we have coke, we have lime. We have also enormous colonies and unrivalled shipping facilities. We ought to be able to stop the importation of foreign carbide into the United Kingdom and its dependencies—not by legislative interference, but by fair commercial competition—and we ought eventually to establish a trade in carbide manufacture, if not in home acetylene consumption, in comparison with which the present English output should be insignificant and contemptible.

PARIS DRAINAGE AND WATER SUPPLY.

If heavy expense and optimistic reports count for anything, the works carried out in Paris for supplying water and for disposing of the sewage ought to be as satisfactory as it is possible to make them. The sums spent upon these undertakings have been colossal. The municipal engineers set to work to create a supply of pure water that should never fail, and to divert the sewage on to the farms so that no more should find its way into the Seine. The latter project has been under execution for many years, and the Parisians were devoutly thankful to the municipal engineers for this anticipated conversion of the Seine from a turgid and evil-smelling river into a clear stream. When at length the collector at Asnières was closed, MM. Bechmann, Launay, and Defrance, who were responsible for the works, declared that their promises were fulfilled. A few hours after this official ceremony, amid mutual congratulations, there was a storm, and the collector, which had been closed for a time, was opened again to let the drainage flow into the river. The municipal engineers had quite forgotten the rain. Those who visited the Paris Exhibition must have been struck with the bad state of the Seine, as it carried down offal and refuse of all kinds, forming a curious contrast with the wealth and elegance represented by the palaces on each embankment; but if visitors had gone further down the river to the point where the big collector at Asnières still belches forth the sewage of the city, they might be excused for wondering what had come of all these years of expenditure and effort. At the time the new sewage farm at Méry and Pierrelaye was inundated we fully described the Paris sewerage system, and explained why, if Gennevilliers and Achères had so far given no serious cause for complaint, the farms at Méry, Gresillons, and other places were utterly unsuited to absorb the matter put upon them, either through the calcareous nature of the strata underlying a very thin alluvium of sand, or because the low-lying land constituted a sort of basin. These facts were insisted upon in the report of Dr. Bourneville long before the municipal engineers extended the mains to these districts. Not only have they made a serious mistake by establishing farms in most unsuitable places, but they have diverted four or five times as much sewage on to the farms as they were stated to be capable of absorbing. Achères was to have received 40,000 cubic metres per hectare a year, but the actual amount discharged has been as much as 200,000 cubic metres. It is not surprising, therefore, that the fissures in the calcareous soil of Méry should have been choked up and the sewage should have flowed off into the wells and cellars, or that Grésillons, a peninsula formed by the Seine, should have become a foul swamp, poisoning the wells and destroying the foundations of houses. A few months ago the Commission which was appointed to examine the sewage farms recognised the evils complained of, but being naturally anxious, for the sake of the Municipal Council, to put matters in as favourable a light as possible, suggested that the inundation was a temporary inconvenience which could be remedied by the carrying out of certain works. Thinking themselves shielded by this report, the municipal engineers continued to discharge sewage on to the farms, and only desisted when the inhabitants backed up their protests by legal proceedings against the Council. Since then the collector at Achères has been pouring sewage into the Seine. The Commission expressed the opinion that the evil would right itself when the water "found its level." So far, however, from there being any diminution of the inconvenience, it has actually increased, and the state now is worse than it was at the time the report was published. At Méry the Paris Municipal Council is still sending round water-carts, and is doling out water from the Oise—which itself receives a good deal of sewage—at the rate of 100 litres for each inhabitant for three days. At Pierrelaye the municipal engineers have sunk a well, or sump, from which the water draining off the land is pumped, but the inhabitants complain that this has in no way minimised the evil. Their wells are permanently poisoned. The trouble is not limited to the inundations. A new source of opposition to the *tout à l'égout* system has broken out at Achères, where the agricultural classes were inclined to tolerate the sewage on the strength of statements that this new system of fertilisation would enormously increase the value of their crops. It is true that the beetroot and other tubers grew to an amazing size, but when farmers came to sell their produce they found they could not get a fair price for it because the quality was poor. The roots, having absorbed so much water, were tasteless, and were very low in organic constituents. The unfortunate farmers have combined to bring an action against the Municipal Council to recover damages to the extent of 300,000f. Of course, it is the Parisian ratepayer who has to bear the burden of these mistakes. He has already been brought under heavy contribution for the creation of these sewage farms, which have proved an absolute failure, and his troubles are not yet at an end. Still another point about the *tout à l'égout*, apart from any question of suitability of soil, is the difficulty of conveying the sewage any great distance from the city without its becoming an intolerable nuisance. Gennevilliers is situated not far from the elevator at Clichy, and the soil, being composed of a thick stratum of sand, is all that can be desired for a sewage farm; but though the sewage is only conveyed a short distance the proximity of the farm is plainly evident to those passing through the district. As the sewage travels through the mains it has time to acquire odorific properties that make it extremely unpleasant as it is discharged at Achères, while further on, at Gresillon, the smell is unbearable. How it will be in the event of MM. Bechmann and Launay extending the mains in the direction of Mantes, as they propose, had better be left to the imagination.

If the sewage farms are a failure, it cannot be said that the municipal engineers have been more successful in carrying out their promise to provide Paris with an unfailing supply of pure water. They have done much, it is true, but not enough, and the Parisians complain that their money has not been spent to the best advantage. When the project for bringing water from the source of the Loing and the Lunain was under discussion M. Bechmann affirmed most emphatically that the Parisian would never find it necessary to employ Seine water for household purposes. These works were to be completed in time for the Exhibition, and, in fact, water from the Loing and the Lunain began to be distributed in May last. It was estimated that these sources would provide 50,000 cubic metres a day. It is found that they only give just half this amount. The total quantity that is supposed to be distributed every day is 240,000 cubic metres—that is to say, 25,000 from the Dhuys, 100,000 from the Vannes, 90,000 from the Avre, and 25,000 from the Loing and Lunain. This represents about 100 litres per head of population. Such an amount ought to have been amply sufficient during the summer months, and we dealt with a report of the municipal engineers presented to the Council at the beginning of the year, when they stated that the new sources would augment the supply to such an extent that even during the Exhibition it would not be necessary to use Seine water. And yet visitors would probably have been a little uneasy had they been aware that for four months the Ivry basins, which are constructed upon the Puech system, and are notoriously inefficient and unsanitary, supplied imperfectly filtered Seine water, which was pumped to Ménilmontant and mixed with water from the Dhuys aqueduct. Again, the water of the Vanne, which is the purest source supplying Paris, became contaminated at Sens through the Paris engineers mixing it with drainage water because the supply was not sufficient; and it is a striking coincidence that both at Sens and Paris typhoid fever assumed rather alarming proportions. Parisians urge that, as they have paid more than 120,000,000f. for their water supply, they may reasonably expect to have it pure and in sufficient quantities. The Dhuys aqueduct, having a length of 131 kiloms., was terminated by Belgrand in 1865, two years after the works had been started, and the total cost, including indemnities and the purchase of the source, was 18,000,000f. The Vanne aqueduct, of a length of 173 kiloms., was begun in 1867, but the works being interrupted by the war, they were not terminated until 1874. The total cost was 49,000,000f., the aqueduct itself absorbing 27,500,000f. The Avre aqueduct has only a length of 103 kiloms., and was started upon in 1884 and completed in 1893, thus taking nine years. The total cost was 35,000,000f. The project for utilising the sources of the Loing and the Lunain was discussed twelve years ago, but it was only in 1895 that the Municipal Council voted the sum of 18,450,000f., which was estimated necessary to carry out the works. The cost of the undertaking is not yet known, but in the light of past experience it may reasonably be supposed that this sum has been far exceeded. Not only do ratepayers pay dearly for water that is not always supplied to them, but there is really no reason why there should be at any time a dearth of supply. The watershed which gives rise to innumerable small tributaries to the Seine provides plenty of sources within convenient distance of Paris, and the Municipal Council long ago purchased several of these sources, which, if utilised, would pour on abundance of water into the city. The secret of this abstention is the extravagance of the socialist Council, which is finding every year an increasing difficulty to make ends meet, and when it comes to a question of spending millions upon necessary works, several years are devoted to fruitless discussion upon the ways and means.

This question of water supply, and more especially the recent prevalence of typhoid fever resulting from the contamination of the Vanne water, was lately considered by the Seine Council of Public Health, when it resumed the discussion in a series of suggestions. The Council thought that it should be given a more effective control over the water supply in the department of the Seine, that a protective zone should be established around the sources supplying the city; in other words, that precautions should be taken to prevent these sources from becoming contaminated by stagnant ponds or in other ways, that the sources should be frequently inspected and the aqueducts sufficiently protected throughout their whole length to prevent any danger of contamination, that the water should be purified either by filtering or by sterilising, with which it was proposed to carry out further experiments, and that the different sources on their arrival in Paris should not be mixed, this last-named recommendation evidently being prompted by the theory that microbes flourish very strongly when they are transferred from one water to another. It is characteristic that M. Bechmann opposed the recommendation to prevent any mixing of water from different sources, and objected to the Council exercising any control over the water supply. At present the municipal engineers are under no control whatever.

With the exception of one company—the Great Western—all the principal railway companies of the United Kingdom have expended a larger sum upon capital purposes than the cash received by the issues of capital.

PARIS EXHIBITION—1000 HORSE-POWER TANDEM COMPOUND ENGINE

ESCHER, WYSS, AND CO., ZURICH, ENGINEERS

Fig. 3.

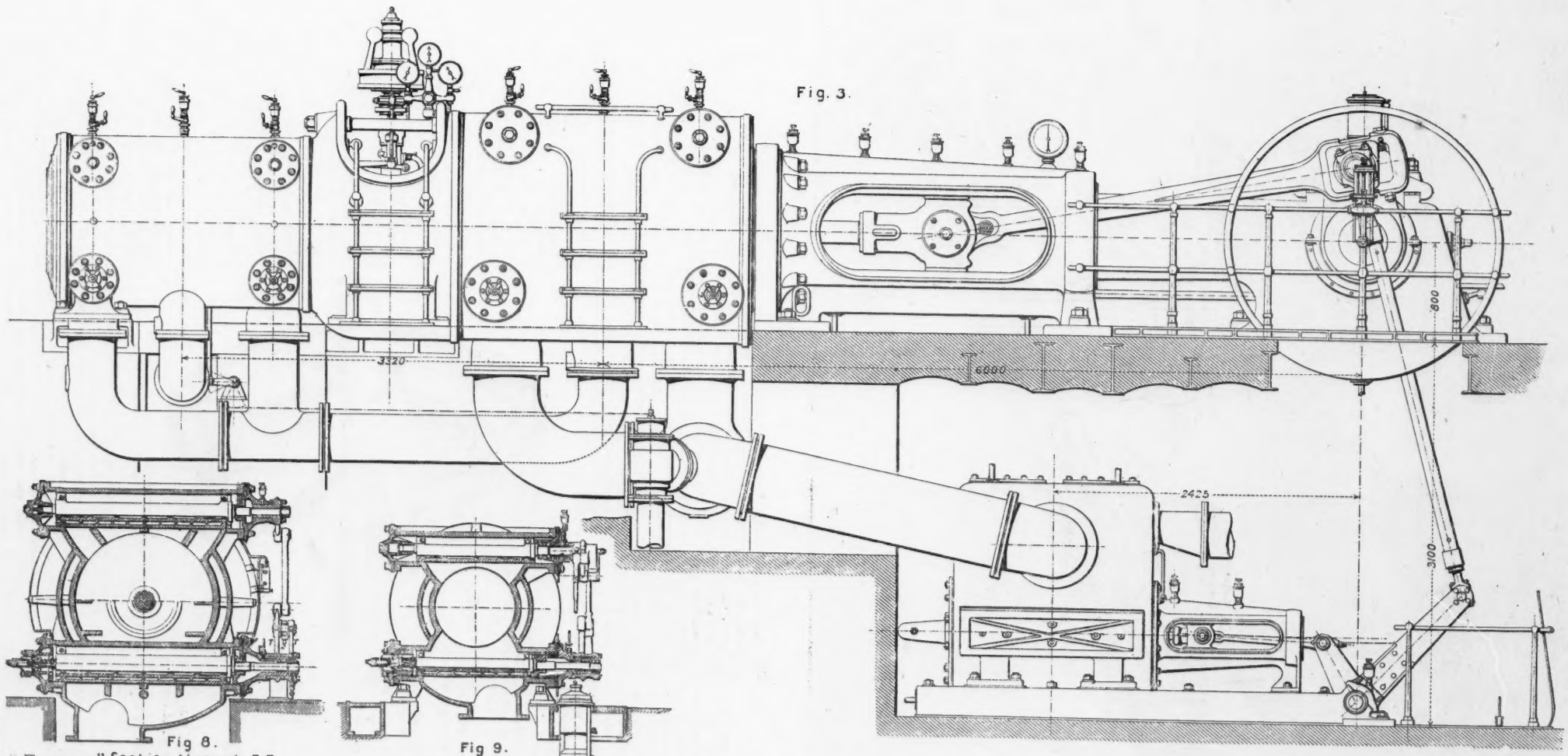


Fig 8.

ENGINEER "Section through E-F.

Fig 9.

Section through I-K.

SWAIN

PRIME MOVERS AT THE PARIS EXHIBITION.

No. XV.

SWISS SECTION:—ESCHER, WYSS, AND CO.

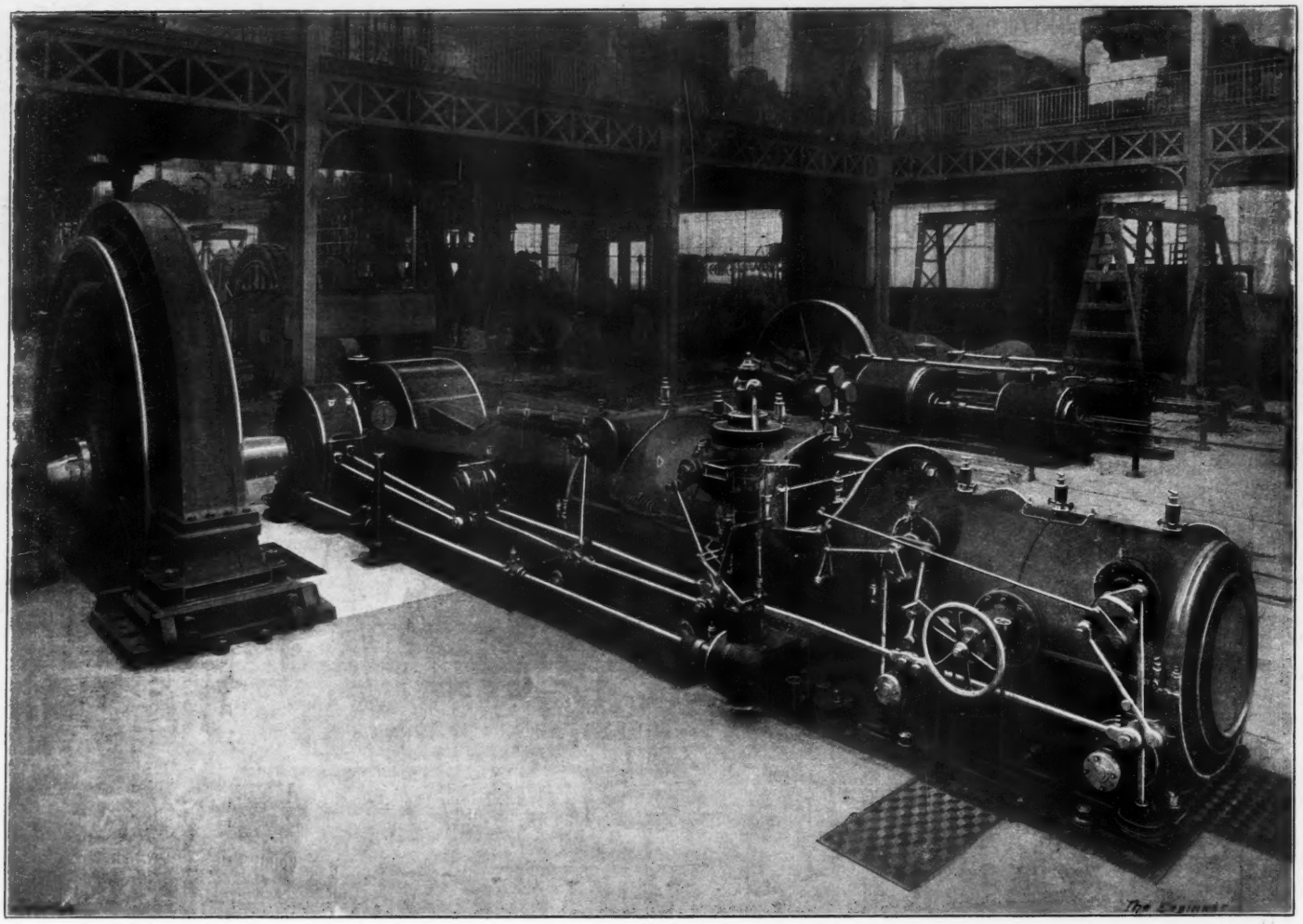
OUTSIDE France, the engineering of no country was more amply represented at the Exhibition than that of Switzerland, in proportion to its size and population. Among the Swiss exhibits we found, as was natural, turbines taking a strong place, the chief exhibitors being Escher, Wyss and Co.; Theodore Bell and Co.; Piccard, Pictet, and Co.; J. J. Rieter and Co. Some interesting air compressors with special forms of slide valve were shown by Burckhardt, of Bâle, and these we hope to illustrate later on. Among the steam engines, Sulzer Brothers occupied the greatest space, as was due to the importance of their works. Their engines were among the best in the Exhibition, and on another occasion we will give our readers details of the more interesting portions of these machines. After these come the engines of Escher, Wyss, and Co., whose works are at Zurich. Of these engines we give to-day drawings and details.

Their largest engine shown was a 1000 horse-power horizontal compound, with the cylinders placed tandem. Fig. 1 gives a general perspective view of this engine. It drove an Oerlikon dynamo, designed as a tri-phase of 1300 kilowatts at 5500 volts. In the Exhibition, however, the three armature sections had been coupled up in parallel for the generation of monophase current at 2200 volts. The dynamo was mounted direct on the engine shaft, the exterior armature being fixed to a pair of special bed-plates with horizontal and vertical adjusting screws to get it exactly concentric with the field-magnet pole surfaces attached to the internal fly-wheel. Details of this dynamo and its exciter will be given in our electrical articles.

Fig. 2, page 585, is a plan of the steam engine; Fig. 3 an elevation looking towards the dynamo, and showing the injection condenser and air pump; and Fig. 4 an elevation from the opposite side, showing the governor and valve gear. It will be seen that the large cylinder lies nearest the crank. Its front cover, the bored out crosshead guides, and the main bearing plummer block, are all cast together in one very massive piece of great stiffness. The crank overhangs this bearing, and it and the front end of the connecting-rod move inside a light steel sheet hood casing. The crank and all the revolving and reciprocating masses are very carefully balanced for longitudinal acceleration. The main bearing is shown in section in Fig. 5. Its diameter is 400 mm., and its length 750 mm., giving a diametral bearing area of 465 square inches. It is a four-part bearing, each side quarter being adjustable horizontally by screws. These quarter bearings are of cast iron, heavily lined with white metal, and abundant lubrication is provided, all the oil being collected and returned. On the dynamo side of this bearing come the two main excentrics, one serving each cylinder. Each sheaf has a bearing width of 130 mm., and is of cast iron lined with white metal. Beyond these there is keyed to the shaft a cast steel skew spur wheel driving a horizontal side shaft at twice its speed. This shaft extends only as far as the point L—see Figs. 2 and 4—where it drives a revolution counter and a speed indicator, and where it is coupled to a parallel horizontal side shaft by spur gearing, giving this latter a speed 1½ times greater. This shaft drives the vertical spindle governor at M—see Figs. 2, 4, and 7—by

PARIS EXHIBITION—HORIZONTAL COMPOUND ENGINE

ESCHER, WYSS, AND CO., ZURICH, ENGINEERS



bevel gear, which again increases the speed in the ratio of 2 to 3. The governor speed is thus four times that of the main crank shaft. Figs. 3 and 5 also show the centrifugal lubrication of the crank pin through a light return crank; and the same drawings show the connecting-rod and bell crank drive of the horizontal air pump, whose diameter is 480 mm., with the comparatively long stroke 550. As the normal speed is 105 revolutions per minute, and this pump is double-action, it is evident that it is pretty hard worked, the mean piston speed in the pump being 115½ m. = 385ft. per minute. At the Exhibition the speed has been somewhat less than 100 revolutions, and a vacuum of 660 mm. mercury is obtained. There is ample fall and gradient from the bottom of the cylinder to the condenser.

Fig. 6 is a cross section of the guides and crosshead. This latter is a steel casting, but its slippers, which swivel freely on vertical pins, are of cast iron. The lower one is lined with white metal, and the upper one is adjustable by screw and nut. A cooling water circulation is provided through the hollow *n* of the lower guide, this form of section having been, however, probably chosen primarily in order to give greater stiffness.

Fig. 7 is a cross section of the trough-shaped casting connecting the two cylinders. It is seen also in Figs. 2, 3, and 4. This is open at top, giving free access to the stuffing-boxes, and also allowing the low-pressure piston to be withdrawn this way. The open top is braced across by a heavy steel bolt. In this place there is fixed a half-bearing to carry the weight of pistons and rod. It is lined with white metal, and is adjustable in level. This figure also shows the governor in section. It is of the inverted bell-crank two-ball type, with central spring. A pair of outside spring tension bolts acting upon the sleeve, and a screw lever, seen in Figs. 2 and 4, serve to adjust the speed 5 per cent. up or down from normal. The vertical governor shaft gears with the short horizontal transverse shaft *p*—see Figs. 2, 4, and 7—in a ratio which makes the speed of this spindle *p* the same as that of the main crank shaft. At its inner end this spindle carries a disc crank giving movement to part of the high-pressure valve gear.

Figs. 8 and 9, page 583, give sections of the low and high-pressure cylinders and their Corliss valves. The inner eccentric drives the low-pressure exhaust valves through the swing arm *s*—see Figs. 2, 4, and 6—and the double lever *r r* and rod *q*—see Figs. 4, 8, and 2—with simple harmonic motion. A positive motion, without trip, is given to the low-pressure admission valves by rods from the upper ends of the inner halves of the double levers *r r*. The outer excentric drives the swing arm v_1. This is cast in one piece with v_2—see Figs. 6, 4, and 2. This piece swings on a pin bolted to the side of the guides, and the other swing arm *s* has its bearing on the middle part of the boss of $v_1 v_2$. The bearings for both these swing arms are lined with white metal. The arm v_2 gives the main motion for the high-pressure valve gear in a manner similar to that described for the low-pressure gear, except that, in the case of the high-pressure, the centres on the exhaust arms, from which the connecting links lead upwards to the admission arms, do not lie on the same radii of these exhaust arms as the attachment pins of the horizontal driving rods. The high-pressure exhausts are without trips. The trips on the admissions have large strokes and large engagement wearing surfaces. The pallets are disengaged by bell-crank arms *w w*, see Fig. 4, which are oscillated, the two in reverse directions, by the rods *x x*. These obtain their movement from the three-armed bell crank *y y y*.

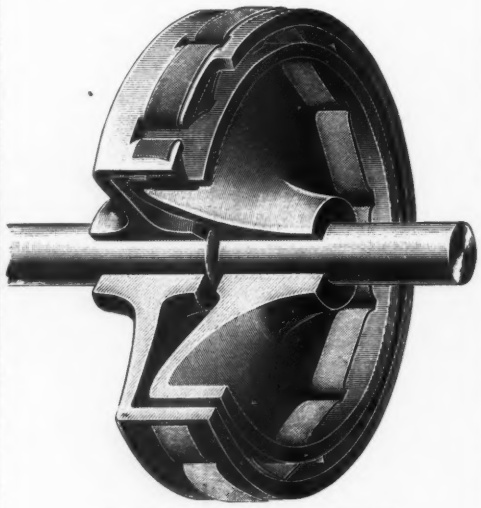


Fig. 10—ZODEL FLEXIBLE COUPLING

The joint *v* of this bell crank is guided to and fro on a circular arc centred at V. The same joint is oscillated on this path by the connecting-rod *z*, pinned at its left-hand end to the disc crank on the spindle *p*, already mentioned as being driven from the governor shaft. The left-hand end of the horizontal arm of the bell crank *y y y* is suspended from the governor sleeve, and rises and falls with the speed of the engine. This has practically the same effect as a simple lengthening of the long rod *x* and shortening of the short rod *x*, whereby the cut off is placed earlier in the stroke.

The cylinders are 650 mm. and 1100 mm. in diameter, and the stroke 1200. The normal speed is 105, and the normal cut-off about 25 per cent. of the stroke in the small cylinder. This gives a total ratio of expansion 11¼, the ratio of cylinder volumes being 2⅞. The piston speed is high—namely, 245 m. = 817ft. per minute. The steam pressure is nine atmospheres, and no superheating is intended. Under these normal conditions the steam consumption is stated to be from 5·8 to 6 kilos. = 12¾ lb. to 13¼ lb. per horse-power hour.

On page 586, is given a perspective view of a fine vertical condensing engine of about 300 horse-power, exhibited by the same firm. It runs very quietly indeed at 175 revolutions per minute. It is three-cylinder, three-expansion, with the small cylinder placed between the two others. The cylinders are 320 mm., 520 mm., and 800 mm. in diameter, by 450 mm. stroke, and the engine is built for from 12 to 13 atmospheres steam pressure. All three cylinders are jacketed, the first only with boiler steam. The high-pressure valve is a piston with an interior Rider variable expansion valve; the other two valves are flat slides, with the weights balanced by small steam cylinders and pistons. The three cranks are placed at 180 deg., and the air pump is vertical. The engine is controlled by a small horizontal central spring governor, driven at high speed by a chain from the crank shaft.

This firm deserves to have it mentioned that its engine was one of the very few which were completely ready to start at the time of the official opening of the Exhibition, and that it was only from want of steam supply that they did not run at that date.

They manufacture and exhibited a pattern of flexible coupling which is already extensively used on the Continent for the direct coupling of dynamos, turbines, &c. This is shown in Fig. 10. Two flanged discs are fastened on the ends of the two shafts in alignment to be coupled. The flanges, one of them lying inside the other, are perforated by a series of slots through which is threaded a leather or a cotton belt in such manner that the short stretches of belt lying between the flanges have a nearly tangential position, so that they efficiently transmit the tangential driving effort without waste tension in the belt. This coupling appears to work smoothly, and the belt is said to have a long life in it It is the invention and patent of Herr Zodel.

Escher, Wyss, and Co. also exhibited carbonic acid freezing machines and paper-making machines. Another interesting exhibit was their aluminium launch boat of 20ft. length, 4½ft. beam, and 20½in. draught, the depth from gunwale to keel being 29½in. It seats eight persons, and its weight, fully equipped, is no more than 970 lb. It is driven by a single screw and a naphtha vapour engine, that is, an engine similar in all respects to a steam engine, except in small constructive details, and except that liquid naphtha is used instead of water, its vapour driving the engine in the same manner as does steam. The firm

PARIS EXHIBITION—1000 HORSE-POWER TANDEM COMPOUND HORIZONTAL ENGINE

ESCHER WYSS, AND CO., ZURICH, ENGINEERS

(*For description see page* 583)

Fig. 4.

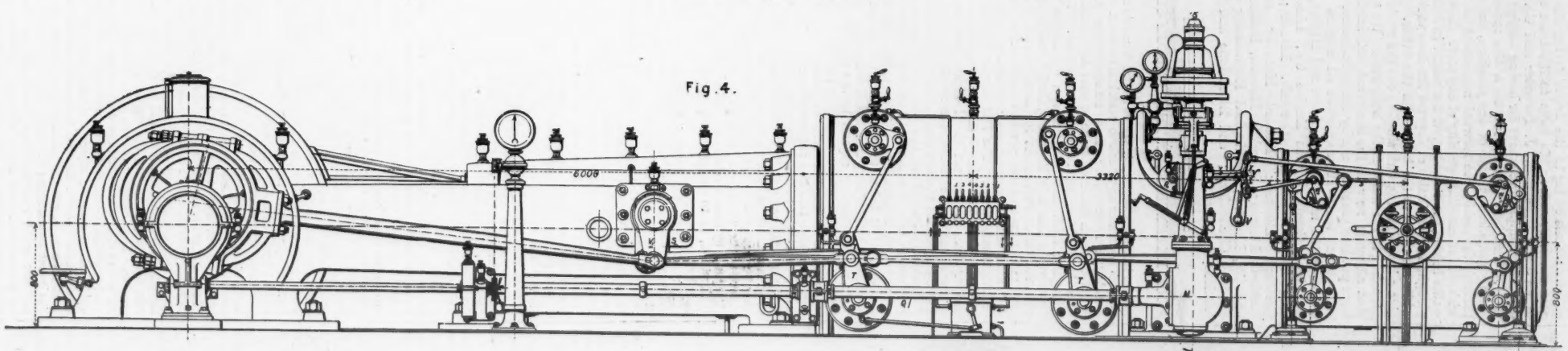


Fig. 2.

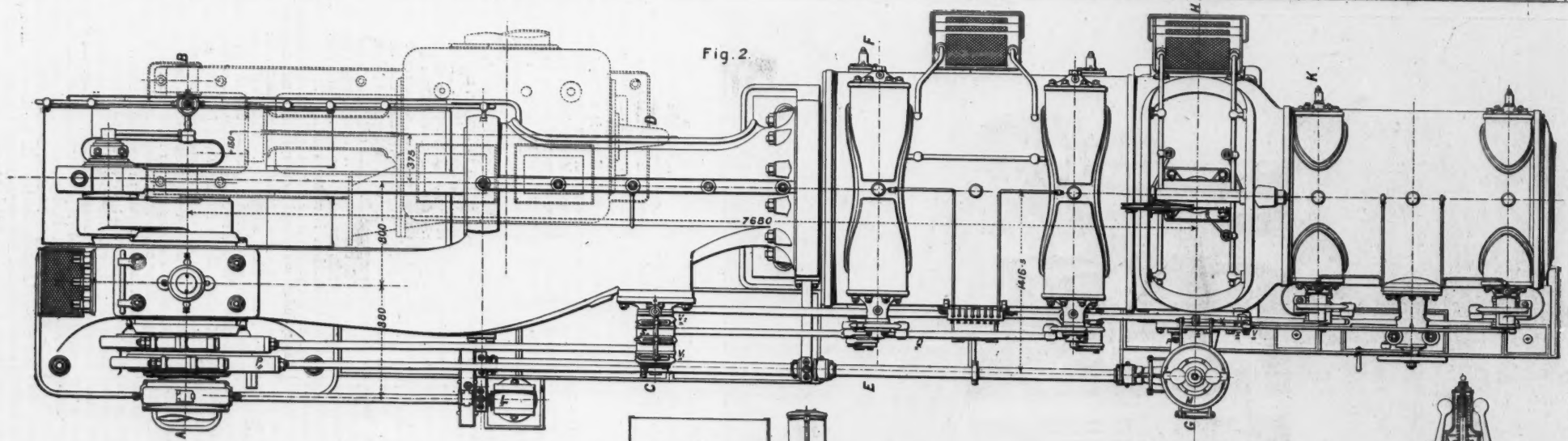


Fig 6
Section through CD.

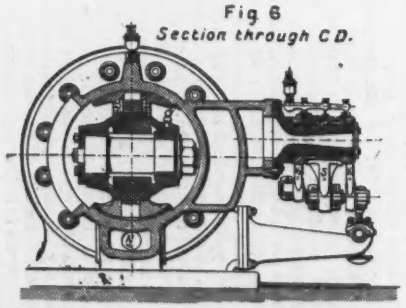


Fig 5.
Section through AB.

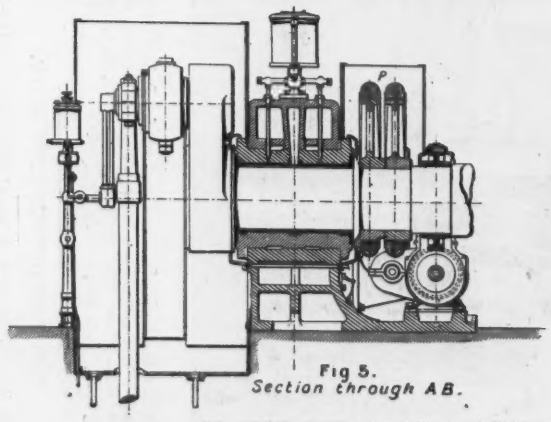
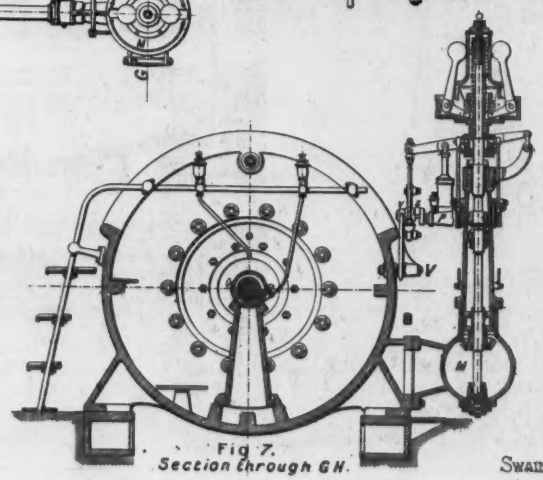


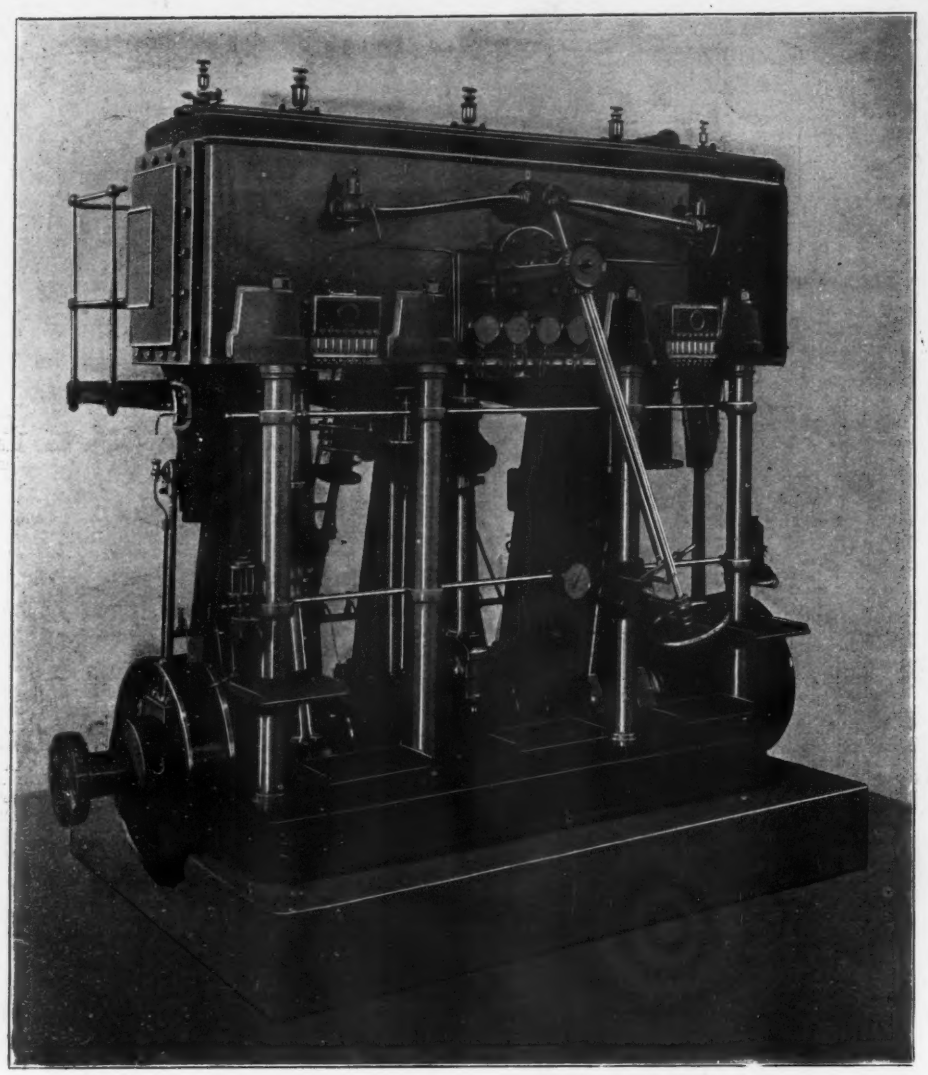
Fig 7.
Section through GH.



SWAIN ENG.

PARIS EXHIBITION—300 H.P. VERTICAL CONDENSING ENGINE

ESCHER, WYSS, AND CO., ZURICH, ENGINEERS



has built a similar boat with twin screws for Lake Victoria Nyanza. This larger boat has a weight of six tons, and will accommodate fifty to sixty passengers, its length being 43ft., beam 9ft., and draught 40in.

THE SMITHFIELD CLUB SHOW.

We have never seen a less interesting collection of agricultural implements and appliances at the annual Show of the Smithfield Club than is shown this year. Not only is there a dearth of novel features, which we have had cause to lament for several years past; there is also a diminution of the number of implements shown. Under the circumstances, a detailed description of the implement section is rendered unnecessary. The primary aim of the Smithfield Club, we understand, is to encourage the selection and breeding of the best and most useful animals for the production of meat, and to test their capabilities in respect of maturity. With this end in view, the Club offers nearly £4000 in prizes. Now we trust we shall not be overstepping the limits of our duties if we suggest that the aims of this wealthy society might with advantage be extended so as to encourage the production of improved farm and dairy implements. With this object a comparatively small portion of the large amount of money offered as prizes to cattle exhibitors might be set aside to promote a keener competition amongst makers of the mechanical appliances which now play such an important part in the economical conduct of a modern farm. It may be retorted that this step is not necessary, that the flatness of the implement side of the Show is due almost entirely to the remarkably busy state of the implement industry, and that when a lull in the orders on hand takes place there will be more life put into the affair. This may be so, but the fact should not be lost sight of that the number of agricultural shows held in all parts of the country has increased very materially in late years, and implement makers have long complained that the expense incurred in having representative exhibits at even a few of them is excessive in comparison with the "business done."

If there is a perceptible falling off in quantity, the remark does not apply to quality, and the degree of finish which modern tools impart to details which were once considered unworthy of so much attention is very marked when a comparison is made with the agricultural implement of a few years ago. It would serve no good purpose to enumerate even a few of the appliances which have now become "stock patterns" with their producers, and we must therefore confine these remarks to the extremely few improvements which are noticeable. Under the head of "improvements" we may, perhaps, be pardoned for calling attention to two decided novelties which have been brought over from the Paris Exhibition. These are mowing machines, in which the motive power is provided by explosion engines employing petroleum spirit. Without entering into the question of the cost of such machines, it seems extremely doubtful whether there is a legitimate want for self-operating appliances of this kind, whatever may be the source of power, while a farmer possessing a mower without a horse or pair of horses to operate it must be indeed a rarity. Time, however, will show whether there is a field for inventive resource in this direction. The machines exhibited by the McCormick Harvesting Machine Company and Deering's have, we understand, been both tested in France, and the former cut two acres of grass in about an hour. This machine has a two-cylinder vertical engine, capable of developing about 5 horse-power. It is suspended from the mower framing in front of the driver's seat, and drives by means of chain gearing bevel wheels, which can be thrown in and out of mesh with the main shaft which operates the road wheels. The engine is water-cooled, and the ignition of the explosive charge is brought about by electric sparks produced by storage batteries. The motive mechanism is rather crude. In the Deering machine the engine is of the two-cylinder horizontal type. The cylinders are placed tandem fashion, and drive on to a common crank shaft placed between them, the explosions taking place alternately. This engine is water-cooled, and has electric ignition device and storage batteries. We are forced to admit that neither implement is of the kind a farmer would be likely to place in the hands of an agricultural assistant, and even if the work can be done with them considerably cheaper than with horses, the saving will be more than balanced by the depreciation of the mechanism from season to season.

The exhibitors of steam engines include: Mr. W. Allchin, Northampton; Aveling and Porter, Limited, Rochester; Brown and May, Limited, Devizes; Chas. Burrell and Sons, Limited, Thetford; Clayton and Shuttleworth, Lincoln; Edwin Foden, Sons, and Co., Limited, Sandbach; William Foster and Co., Limited, Lincoln; John Fowler and Co., Limited, Leeds; Richard Garrett and Sons, Limited, Leiston; E. S. Hindley, Bourton, Dorset; Richard Hornsby and Sons, Limited, Grantham; Marshall, Sons, and Co., Limited, Gainsborough, who have made several modifications in their portable engine; P. J. Parmiter and Co., Tisbury, Wilts; Ransomes, Sims, and Jefferies, Limited, Ipswich; Robey and Co., Limited, Lincoln; Ruston, Proctor, and Co., Limited, Lincoln; W. Tasker and Sons, Limited, Andover; E. R. and F. Turner, Ipswich; Wallis and Steevens, Limited, Basingstoke; the Wantage Engineering Company, Limited, Wantage; and Woods and Co., Stowmarket.

The traction engine exhibited by W. Tasker and Sons, Limited, is a compound, with cylinders 6½in. by 10½in. It is fitted with a new speed regulating gear for speeds of 1¾, 3½, and 6 miles per hour. This gear replaces the usual arrangement of levers for altering the travelling speeds, and is devised so that there is no danger of breakage of gear wheels owing to the driver having two speeds in gear simultaneously. We hope to illustrate this engine in an early issue. R. J. Parmiter and Co. show an extremely simple implement for hoeing turnips and other roots. The hoes are carried on a disc mounted on a spring frame in the rear of the machine, and are drawn through the soil by the forward movement of the horse, without intermediate gearing of any sort. The attendant walks behind the machine, as he would in following the plough, and can raise or depress the hoes with one hand while attending to the horse with the other. The hoes give a long drawing cut, singling out the roots regularly, according to the width of the hoes used. We understand that although new to the showyard, this implement has been put into practical use by the introducers.

As usual there are numerous oil engines exhibited. Amongst the makers are: Allen and Barker, Limited, Taunton; Campbell Gas Engine Co., Limited, Halifax; Clayton and Shuttleworth, Lincoln; Crossley Brothers, Limited; Richard Hornsby and Sons, Limited, Lincoln; J. and F. Howard, Bedford; Robey and Co., Limited; Shillingford Engineering Company, Limited, Cheltenham; and Blackstone and Company, Limited, Stamford.

DOCK EXTENSIONS IN THE BRISTOL CHANNEL.

The truce among South Wales railways continues, though there is no nearer approach to practical terms of amity, or a working agreement, or that amalgamation of identical interests which shareholders in at least three of the companies have been advocating for some years past. Instead of a triangular duel, and sometimes a "foursome" conflict, between the Taff Vale, Rhymney, Cardiff, and Barry directors, the Bills before Parliament for next year are, for the most part, modest requests for power to acquire extra lands to make deviations or to extend the prescribed time for the execution of authorised works. The Bill of the Cardiff Railway—formerly the Bute Docks—is the most important. It seeks a prolongation of the period of eight years in which to complete the South Docks, the construction of which, as already explained in these pages, has been impeded by many difficulties arising from the nature of the ground. The proposal to alter the levels and original course of the new railway from Walnut Tree to Pontypridd, sanctioned in the Act of 1897, is taken to imply that the company intends, after all, to build a line parallel, and competing with, the Taff Vale, notwithstanding reports to the contrary. The most contentious clause is one requiring the Rhymney Company "to provide further and better structural and other accommodation and facilities for the conduct of their traffic to, from, or in the neighbourhood of the Bute Docks of the company, and particularly to provide sidings to such extent, in such manner, at such terms, and in such places as shall or may be provided in the Bill, and to make provision with regard to the working of the traffic of the Rhymney Railway Company by that company." This sweeping proposal, we understand, is to be vigorously opposed by the Rhymney directors.

For the rest, the Bristol Channel will be represented before the Private Bill Committee by an exceptional number of projects for new docks and dock extensions, extending from Bristol westward as far as Swansea, if not Llanelly. It is some years since we remarked that if all the schemes in embryo, or actually incorporated in engineering plans, were ever carried out, there would be a continuous line of docks from Newport along the coast to Swansea. As it is, only a few miles intervene between the Alexandra Dock at the former port and the Roath Dock at Cardiff; scarcely a mile between the Bute South Dock, and that which the Taff Vale Company is quietly but busily expanding at Penarth; some six miles westward, and there are the capacious docks at Barry; and within intervals of walking distance there follow the harbour of Porthcawl, which is to be modernised and developed; the new and apparently thriving dock at Port Talbot; Britonferry, once a prosperous haven in coal and copper; and the Prince of Wales Dock at Swansea. It is of no use asking where all the traffic, that is remunerative traffic, is to come from. The promoters, whether private corporations or public authorities, in each case insist that the growth of trade, more particularly the increasing size of steamers and the necessity of greater facilities for rapid despatch, compel them to extend their accommodation for shipping. Everyone will hope that this enterprising view is, or will be, justified by the facts; and for one thing, it may be mentioned that, whereas the Channel ports, except Bristol, were mainly ports of export during the past decade, there has been a remarkable increase in the import trade all along the line.

From every point of view the Bristol Dock Bill is the most noteworthy feature of what promises to be a pacific dock campaign. For thirty years or more the question of dock extension has been vexing the minds of progressive citizens of the ancient port. When Portishead and Avonmouth docks were added to the dock estate of the city, it was found that shipowners did not care to use the one, and that the constant increase in the dimensions and tonnage of oversea vessels was gradually exceeding the capacity of the dock at Avonmouth. The champions of the plan for dockising the Avon for a long time obstructed the settlement of an undoubtedly knotty problem, and their demands were not appeased until quite recently Sir Benjamin Baker and Sir John Wolfe Barry pronounced a decided judgment against dockisation. Not because it was impracticable, or merely on account of the great expenditure the scheme would entail. As there has been much misconception on this point, it may as well be pointed out that these eminent engineers finally condemned dockisation on the ground of the obstacles in the way of carrying a Bill with that object through Parliament. Sir Benjamin Baker frankly informed the civic authorities that either he or Sir J. Wolfe Barry would assuredly be asked three questions by the Private Bills Committee. "The first was whether dockisation would not affect King-road and other outside entrances. They were not in a position positively to say that it would not. The second question was whether they could give any precedent for such a large interference with the tidal volume. They would

have to say that they could not. The third question was whether there were any reasonable alternative. They would have to say that there were other alternatives." Dockisation was thus disposed of—for another thirty years, as its advocates admit. There remained the question of dock extension at Portishead, in favour of which Sir J. Wolfe Barry had formerly reported as one of the alternatives. But Sir John Wolfe Barry has since said:—"It must be borne in mind that what was in his thoughts when he made his special report on Portishead was that Bristol especially desired accommodation for Atlantic liners at all states of the tide, whereas what it wanted now was a general development of the port. The great objection to Portishead, in his present opinion, was that it was cut off from the Midland Railway, and he held that if the port was going in for dock extension, it must decide on Avonmouth."

That, in brief, was the recommendation of Sir Benjamin Baker and Mr. Hurtzig, as well as of Sir John Wolfe Barry; it had been the counsel of the late Mr. McCurrick, and is also the advice of Mr. W. W. Squire, the docks engineer. The Bristol Corporation, under these circumstances, unanimously approved plans for a second dock at Avonmouth, to the north of and locking in to the existing dock. It is proposed to reclaim a large tract of tidal flats by constructing a sea embankment north-west of Dumbal Island, and by this means and a slight diversion of the Port and Pier and Avonmouth and Severn Tunnel railways, a site about 250 acres in extent will be made available for a new dock and locks, graving dock, sheds, railway station, and other requirements. The dock is to be confined at first to 25½ acres, but so constructed that an enlargement may readily be made when needed. The entrance channel from the Severn will lead to a lock 350ft. long and 85ft. wide, with sills 8ft. below the outer sills of the old dock lock; while the junction cut between the two basins will provide a second means of ingress. The entrance piers to the lock are to be so built that Atlantic liners or other vessels drawing 30ft. of water can be moored alongside and discharge passengers into trains waiting close at hand for a period of two hours before and after high water of ordinary neap tides. The dock will provide 1200 lineal feet of deep-water vertical quays, the shed area is to be 325,000 square feet, and there are 20,000 lineal feet of sidings. The total cost of the undertaking, including land and buildings, is estimated at £1,947,341, or, as the chairman of the Docks Committee—Mr. Howell Davies—explained, some £200,000 more than the discarded Portishead scheme, and about £1,000,000 less than the dockisation project.

The parliamentary notices specifically describe the Bill as one authorising the Corporation to construct the dock and necessary works, and throughout all the prolonged discussions in the City Council and at the Chamber of Commerce the project has been described as a municipal enterprise to be carried on at the cost of the citizens, who are the owners of the dock estate. We note this circumstance with some particularity, because a different aspect is given to the enterprise by a circular issued by the Dock Extension League of the Chamber of Commerce, in which it is stated, "If the new dock undertaking should be carried out there will be no obligation for any ratepayer to provide a penny of the capital required. This will be asked for and subscribed voluntarily. The obligation of the ratepayers will be the guarantee of the interest on the capital voluntarily subscribed, and the obligation will not begin until the work is completed and in a condition to earn revenue." If this statement accurately represents the facts of the case, it seems strange that it was not made in the course of more than one controversial debate in the City Council chamber.

Newport, on the opposite coast, lost its chief initiative spirit when Sir George Elliot died, and the Alexandra Dock Company, since its former chairman passed away, has been vainly struggling with a problem not unlike that which perplexed Bristol. The Usk, like the Avon, is awkward, and sometimes dangerous, to navigate, especially at night, owing to its inadequate lighting, and, shipmasters say, on account of the indifferent dredging as well. Then, however, unlike Bristol, there has been no division of public opinion as to the need of dock extension and graving dock improvement, nor has there been anything like the same controversy in regard to the remedy required. Of recent years the port has rapidly developed on the east bank of the river; Lysaght's works have been built there; other industries are springing up on land which had hitherto been marsh and waste; and the Harbour Commissioners have been urged over and over again to provide wharfage or quayage on this east bank, or in some way to provide the shipping facilities which, it is alleged, the Alexandra Dock Company would not or could not supply. The company has at last been stirred into action, and though it does not propose to build a new dock, as local shipowners and merchants desired, it is asking Parliament for authority to carry out a scheme which Sir George Elliot strongly urged upon his colleagues in reference to the entrance to the dock basin. The entrance lock opens on to the Usk at a difficult angle and at a very awkward place in the channel. It is now intended to construct a new deep-water entrance to the South Dock between the mouths of the Usk and the Ebbw, and practically direct from the Severn Sea. A diversion of the Ebbw, an unnavigable and occasionally torrential stream, form part of the plan, and perhaps the chief engineering task. But with direct access from tidal waters, the Alexandra Docks are likely to regain their lost popularity among shipowners. Greater facilities for loading and despatch are to be afforded by the construction of six short lengths of railway to relieve the congestion of traffic on the lines connecting the dock system with the Great Western Railway. Power is also asked to employ electricity for lighting at the Alexandra Dock and the Old Dock, and to utilise that agency and hydraulic power in the appliances connected with the working of the docks estate.

Swansea has not been accused of lack of dock accommodation, nor can it be said, as is alleged of Bristol and Newport, that for want of accommodation trade is passing by the port. Swansea has suffered much from the depression in the tinplate manufacture, but it appears to have been compensated by the recent and rapid development of the anthracite coal industry, and the marked increase in the transatlantic commerce, mainly in foodstuffs. The defect of the Swansea dock system is that, with the exception of the basin named after the Prince of Wales, who opened it, the docks are in the wrong place, difficult of access, and decidedly old-fashioned in arrangements and equipment. The Harbour Trustees of the port are applying for powers to expend an estimated sum of £1,000,000 in building a new dock and lock on the foreshore south of the Port Tennant Copper Works. It is also intended to enlarge the half-tide basin of the South Dock, and extend the west pier, and lay down five short lines of railway.

NEW TYPE OF PUMP.

THE pump illustrated by the accompanying engravings is of a new type in that it is not widely known, but a good many have already been made, and have proved themselves

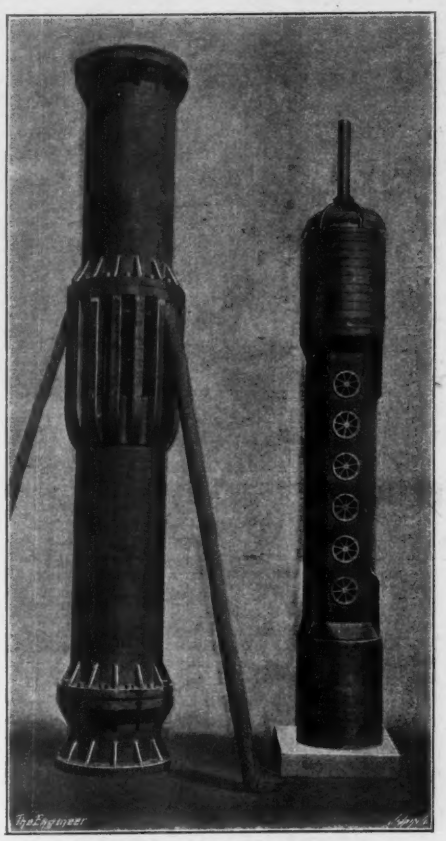


Fig. 1—ASHLEY'S PUMP

satisfactory. The particular pump illustrated in Fig. 1—which shows the barrel and bucket separately—is one of a set which has been recently completed for the East London Water Company. The diameter is 20½in., and the stroke

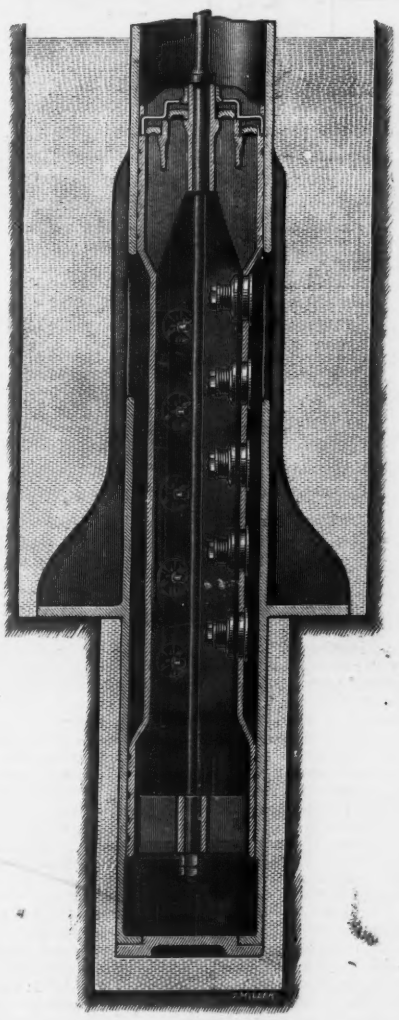


Fig. 2—SECTION OF PUMP

42in. These pumps are made by Glenfield and Kennedy, Limited, of Kilmarnock, under the patent of Mr. Herbert Ashley. The construction and working will be understood at once from the section, Fig. 2, which shows the bucket in position. The lower end of the working barrel is, it will be observed, closed, but a lantern of large area—see Fig. 1 also—allows the admission of water. The bucket fits the barrel above and below this opening, but its central part is provided with a large number of circular valves opening inwards. The lower end of the bucket is open; the upper end is provided with double-beat delivery valves. On the up-stroke of the bucket water enters through the valves, filling the bucket and the barrel below it. On the down-stroke, the bucket descends through this water, lifting it on the next up-stroke.

The principal advantages claimed for this form of pump are perfect accessibility and quicker running. The justice of the first claim is at once apparent. There is no independent bottom or foot valve, both the suction and delivery valves being fitted in a bucket which can be readily withdrawn for inspection or renewal. The second claim rests on the fact that a very large area can be given to the suction valves—that is, their number may be increased. The pump, on account of its construction, which permits of large valve area without great diameter, appears to be particularly suitable for bore-hole work, where the cost is proportional to the diameter of the tube. The construction of the pump involves, it will be be understood, no alteration in the rising main, surface plant, and so on. Other designs of pumps, working on the same principle, are also made, to adapt it to various applications.

DOCKYARD NOTES.

THE Italian project of naval construction for 1901-1912 will entail a cost of 389 million lire, spread over three periods:—(1) 1901-1904, 203 millions for work in hand and five ironclads of 10,000 tons—24 millions each—sixteen destroyers, two auxiliary vessels, and reconstruction of the Italia and Lepanto. (2) 1905-1909, 139 millions for five more 10,000-ton ironclads, two auxiliary ships, one other ironclad, and eleven torpedo boats, to replace obsolete ones. (3) 1910-1912, 77 millions to replace obsolete vessels.

THE ships at present under construction or about to be commenced are the Vittorio, Emanuele III., and Regina Elena, at Spezia and Castellamare respectively. These constitute a new type of armoured cruiser or very swift battleship, approximating curiously nearly to our United Service Institution prize-essay battleship, by Major Field, of the Marines—that is to say, with two 12in. only. The secondary armament is, twelve 8in. quick-firers, twelve 3in., twelve 3-pounders, and two submerged torpedo tubes; armour, Terini system; belt and turrets, 10in.; bulkheads, 8in.; on the 8in. guns, 6in.; displacement, 12,625 tons; indicated horse-power, 20,000; speed, 22 knots; coal, normal, 1000 tons; maximum capacity, 2000 tons. A few ships of this sort, and protected cruisers must make about 30 knots or else cease to exist. As things are to-day, plenty of naval officers hold the protected cruiser to be a well-nigh useless sort of craft—she is so easily blown to pieces.

STEPS are being taken to replace the roofs that till recently were a feature of the three old dry docks near King's Stairs, in Portsmouth dockyard. Last summer the roofs were pulled down, for no obvious reason. Now they are more or less to be put back again.

IN the current *Naval and Military Record* there is a long and interesting letter from Staff-Captain Osborn concerning Plymouth Sound, in which it is mentioned that there was a full moon when last the Devonport defences were "tested" and "found impregnable" against torpedo attack. The writer doubts whether an enemy would be equally obliging, and says that, in his opinion, an attack would get home on a dark night. This is an interesting rider to a contention that we have frequently put forward in this column, that these "testings" are practically arranged beforehand. Torpedo officers aver that in order to prevent mistakes the forts are always told the exact time that the attacking boat is to come in.

THE Russian coast-defence ship Admiral Boutakoff has been altered again—though we cannot affect surprise. She is now going to be of 5000 tons instead of 6000, and her armament one 12in., two 8·4in. quick-firers, and four 6in. This latest Admiral Boutakoff will be like the Apraksin in form, with the big gun in the after turret, and the 8·4in. in the fore one. She will be an interesting ship to look up in all the naval annuals next year.

THE Queen and Prince of Wales, new battleships, will be of 18,000 tons, and carry four 12in., Mark IX.; eight 7·5in. on the main deck; eight or ten 6in. on the upper deck; or else the 7·5in. turrets on the upper deck, and the 6in. in battery on the main deck. Nothing is very definite as yet. More than a year ago we prophesied that the 15,000-ton limit would not last long.

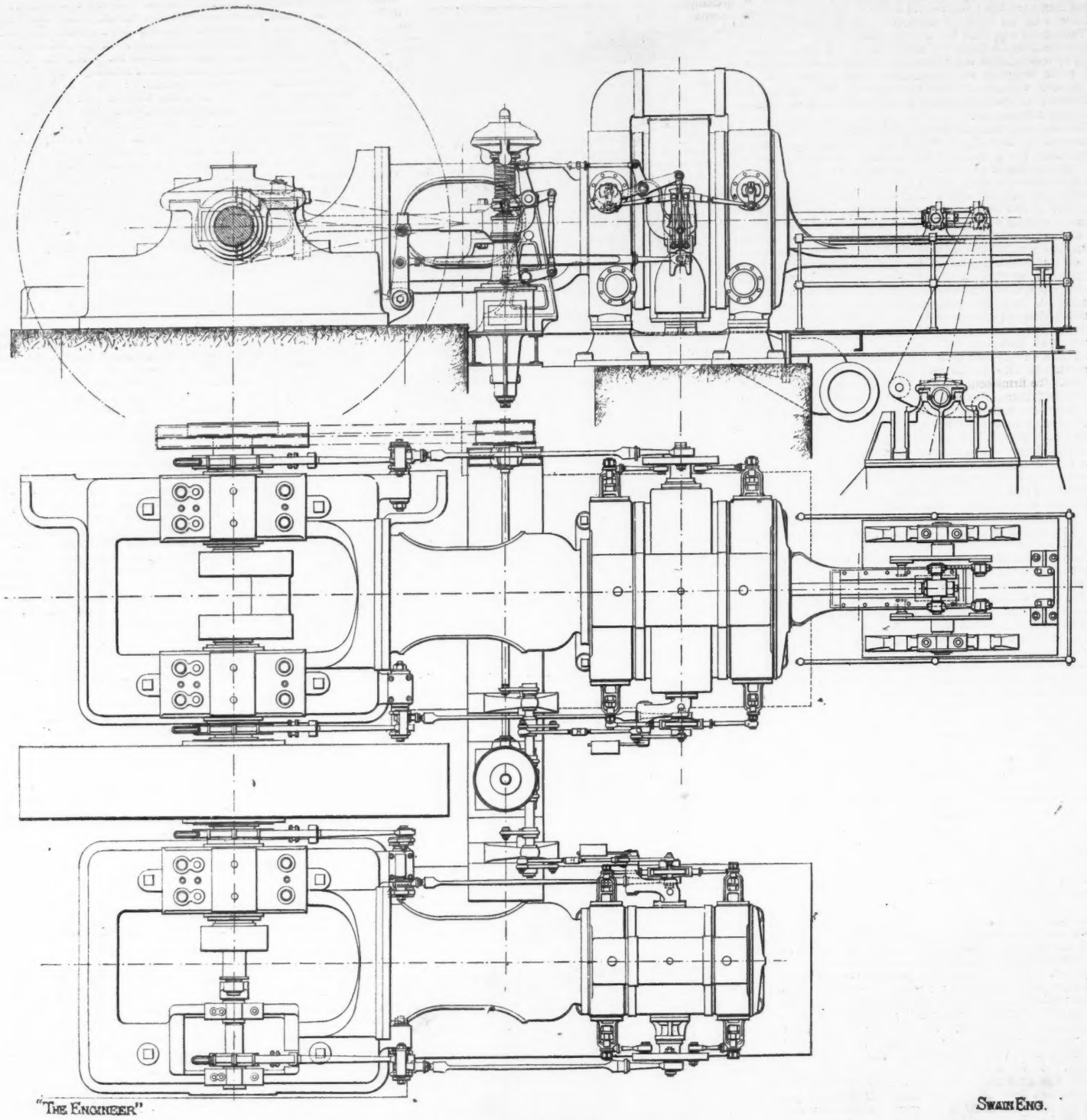
ANOTHER epidemic of "pleas for moderate dimensions" is likely to set in; but for ourselves we shall not sympathise with the movement. A mean is useless. Ships must be very big or else very small. All the evidence and reasoning that we can lay hands on goes to show that a big ship is always better than her weight in small ones. On paper the small ones may look all right to the amateur critic, but the amateur critic always forgets one thing, and that is that while a 15,000-ton ship only occupies a space of 400ft. by 75ft., three 5000-tonners would spread over a space of 2500ft. or more in length. That length, the best part of a thousand yards, would make all the difference in the shooting, and the leader would stand to be smashed before number three had got a look in. Hard facts of that sort upset the prettiest imaginable energy of fire tables. The little ships, too, are bound to be slower, less seaworthy, and less able to stand the terrific shock of a modern big projectile. Supposing it possible to have made the whole of the Majestic class into one enormous battleship—a fleet in herself—such a vessel would be invulnerable to all present methods of attack. The units of the Majestic class are none of them this. The French arguments in favour of 30,000-ton ships were perfectly sound.

THE approximate mileage of the electric railway schemes for the metropolis which are to be brought forward next year is sixty-seven. If the cost of these be taken at the average cost per mile of the existing "tubes," viz., £600,000, the capital required will exceed 40 millions sterling. These particulars do not include the conversion of the Inner Circle to an electric railway.

LEEDS TRAMWAYS—HORIZONTAL CROSS COMPOUND ENGINE

JOHN FOWLER AND CO., LIMITED, LEEDS, ENGINEERS

(*For description see page 589*)



"THE ENGINEER" SWAIN ENG.

LONDON WATER SUPPLY.

THE Bill which the London County Council are, in spite of the many rebuffs which they have received, putting forward in Parliament during the coming session professes to have been drafted with "due regard to the policy which has already been laid down by the Council, and also to the recommendations contained in the report of the Royal Commission on the Metropolitan Water Supply, published in January last." The foregoing quotation is taken verbatim from the report of the Parliamentary Committee of the Council. In connection with the first portion of the quotation there is no remark to make, saving that the Council are evidently determined, in the face of every indication that no success will result from their action, to waste further public money in promoting this Bill. Such waste of public money we have already stigmatised as scandalous. What can be said further? The pity is that the public cannot be brought to a reasonable view of the matter, and appear to think that a sort of millennium—as regards water supply—would exist under the Council's rule. The one bright light on the matter is that indications are at present decidedly against the Council being permitted to purchase the undertakings of the water companies. There is also a gleam of hope that in the coming general election of the Council in March next it will be found that the new Council may see the errors of those at present in office.

We are afraid, however, that this hope is very small. Be this as it may, the ideas of the present Parliamentary Committee as to what is "due regard" to the recommendations of the Royal Commission are strange, to say the least of them. In the first place, the purchase by the Council at all is in direct opposition to the findings of the Commission. We have already dealt with this point more than once, and there is no occasion to go into it again. Thus, then, at the outset, the Council sets the Commission at defiance. Further, the Council proposes, for the management of the water supply, to appoint a committee which *may* comprise representatives of other bodies and persons not being members of the Council. This, the Parliamentary Committee, in its report to the Council, frankly confesses, "is not in accordance with the decisions arrived at by the Royal Commission." It certainly is not, and this, of course, gives the clue to the Council's present action. The Commission, it will be remembered, suggested that the permanent Water Board should consist of a chairman, a vice-chairman, and thirty members, ten of whom were to be appointed by the London County Council, the remainder being representatives of other bodies. The Council are evidently not satisfied with even this lion's share, tempered as it is by the fact that the chairman and vice-chairman are to be appointed by the Local Government Board. The explanation given by the Parliamentary Committee is that they are unable to accept this as a just representation of London on the Board, and the proposal is for the Council, after purchase, to appoint a Committee which *may* contain members not Council. It will be observed that it is not stated that these outside members *will* be appointed, but that they *may* be. In our opinion, if there is to be a Water Board, the County Council should not have more members on it than ten out of thirty-two. This would certainly provide for their interests being fully represented.

We have not much doubt, however, that this new Bill will meet with the same fate as those which have gone before it. There is no reason, that we know of, why the present Government should depart from the decisions of former Governments, or uselessly set aside the findings of the Royal Commission.

ELEVEN MONTHS' CLYDE SHIPBUILDING.—Clyde shipbuilders, notwithstanding the somewhat wet and broken character of the weather over the greater part of the month of November, have managed to make a record November output, which, as usual, has been variously reported, but which may be accurately enough recorded as 60,000 tons gross. Considering, too, that there are, as a rule, during December, extra efforts made to complete to the launching stage, and send off the stocks, as much tonnage as possible, in order to swell the annual returns of individual firms, as well as of districts, Clyde builders have every reason to count on a record year's output. Last year, which was the record year in the history of the industry as regards tonnage output, the figures reached 490,000 tons, while this year, unless something quite untoward intervenes, the figure will reach the conveniently round one of 500,000, or half a million tons. A feature of the returns for November—as it has been to a more or less extent in those for previous months—is the large proportion of tonnage built to the order of foreigners. One-half the number of vessels turned out were to foreign account, and these aggregated some 21,000 tons, or 35 per cent. of the total of 60,000 tons. As evidencing the extent to which shipowners abroad—even in countries where shipbuilding is now a rising industry—still look to our home builders for the supply of fresh tonnage, the figures are noteworthy. They are, however, by no means very exceptional as regards the Clyde output, while on the Tyne, Wear, and Tees, the proportion of foreign-owned tonnage to the total produced, is, as a rule, quite as high, shipbuilders in these districts having, even more than those of the Clyde, strong foreign patronage.

LEEDS TRAMWAY PLANT.

In our issue of the 19th January last we drew attention to the two new combined engines and dynamos, the first of which had then been at work some three weeks, at the tramway generating station of the Leeds Corporation. On that occasion we promised to give further details at a later date. This promise we are now able to fulfil. It will be remembered that in the short notice just alluded to we stated that the engines and dynamos—of which there are two sets—were constructed by John Fowler and Co., Limited, and Greenwood and Batley, Limited, both of Leeds respectively, the former firm having also installed the necessary steam and exhaust pipes, and the switchboard. The engines were designed by Mr. J. T. Marshall, of John Fowler and Co., and were manufactured under his personal supervision. The first set commenced running in December last, and the second set in April of this year. Since this time they have run alternately about twenty-one hours per day without, so we understand, giving any trouble whatever. In the case of the first set, at any rate, there was no chance of any trial runs. Immediately the erection was completed the plant was put to work, and that it has run without hitch until the present certainly reflects credit upon both the firms concerned in the manufacture. Tramway generators as many of our readers are aware, are subjected to numberless very severe strains in the course of a day's working. The line may, for instance, be short-circuited, or partially so, for a more or less lengthy period. At such times the momentary load on the dynamo and engine are far greater than the full working load, and the shock comes suddenly. Just as suddenly the load is taken off, either naturally by the disappearance of the short circuit or by means of automatic devices, and the load falls from something very large to nothing in an instant. Our American cousins may at one time have been ahead of us as regards electrical traction generators, but in this and many other instances our manufacturers have shown that when the necessity arises, when the demand for plant comes, they are able to supply machines to do their work perfectly, whatever the nature of the work demanded of them. We dwelt upon the question of the way these engines governed in the reference already mentioned. There is no need therefore to make further mention of it than to say that the range is about 2 per cent. The speed of the engines, which are of the horizontal side-by-side type, is 120 revolutions per minute, which is certainly high for this size of engine. The ordinary running load varies from about 200 to 1400 ampères at 550 volts. Occasionally the ampères exceed 1700 for a short time.

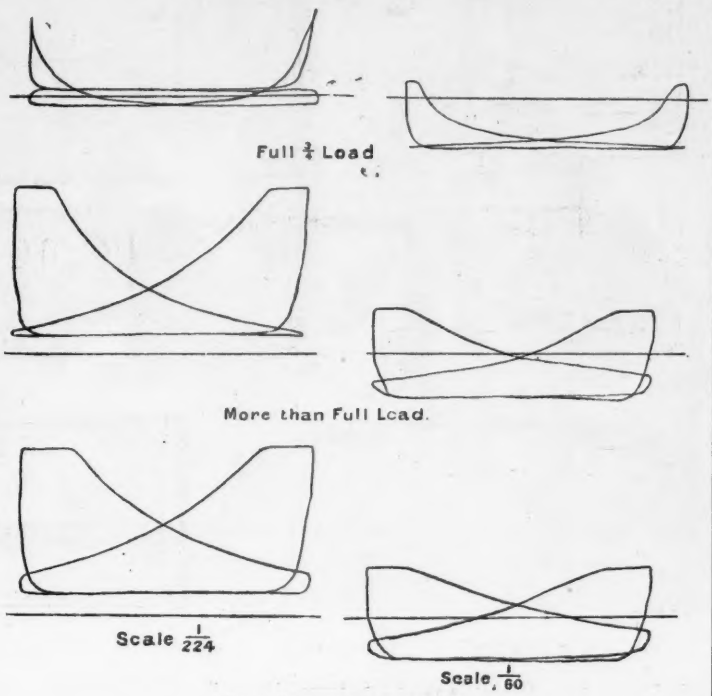


Fig. 1—INDICATOR DIAGRAMS

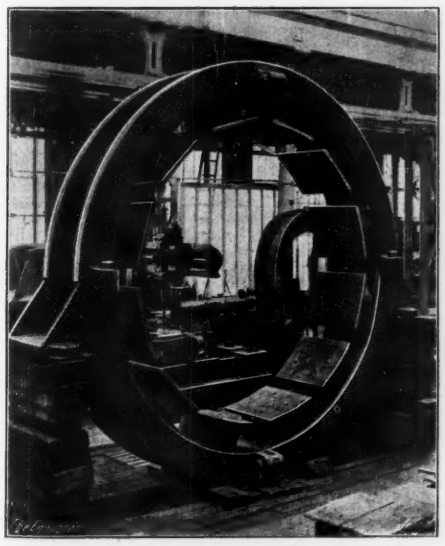


Fig. 2—FIELD RING

The crank shaft is 16in. in diameter and the bearings are 30in. long. The shaft is enlarged to 21in. in diameter where it passes through the boss of the fly-wheel. This is built up of sections which are dowelled together, and placed upon the shaft between the high and low-pressure portions of the engines. It is 15ft. in diameter, and weighs over 40 tons. The dynamo shaft is connected direct to the crank shaft at the low-pressure side of the engine by means of solid couplings forced upon the two shafts. The outer end of the dynamo shaft is carried in a massive bearing which is bolted to the bed of the low-pressure portion of the engine.

The diameters of the cylinders are 29in. and 55in., and the stroke is 32in. This short stroke was necessitated by the high speed at which it was specified the engine should run. It gives the cylinders a rather stunted appearance, which is accentuated by the manner in which they are lagged. The steam is taken by the main steam pipes to the bottom of the high-pressure cylinder and right round the jacket of the cylinder, entering the covers and valve chambers at the top. When the exhaust steam leaves the high-pressure cylinder it is passed through a separator, which is heated with live steam. From this apparatus it passes direct to the jacket of the low-pressure cylinder, which it traverses in exactly the same manner as it did the high-pressure cylinder before passing into the cylinder itself. The two covers are in like manner provided with jackets, which are in connection with the main steam jacket. The cylinders are fitted with Corliss valves made in accordance with Marshall and Wigram's patent, which has already been described in our columns. The valve gear is, however, an entirely new arrangement, and is the subject of a later patent. The main and exhaust valves are double-ported, and are driven by a wrist-plate with one excentric upon one side of the cylinder, whilst the expansion valves are driven by a radius plate connected to a separate excentric on the other side of the cylinder. By this arrangement the expansion gear is brought to the inside of the two cylinders directly under control of the governor, which is placed between them. This method is said to ensure almost constant pressure in the low-pressure receiver, and to enable the engine to deal more easily than it otherwise would with any sudden change of load. On a Moscrop diagram, which we have before us, and which shows the day's working for the 24th of last September, a very nearly straight line, with wonderfully small variations, is shown. The accompanying diagrams—see Fig. 1—reproduced from cards taken from one of these engines, serve to show the excellent manner in which the valve gear carries out its work. It will be observed, too, that even in the heaviest diagrams of the three, which were taken when more than full load was being taken from the dynamo, that there is an ample margin of power.

Particular care has evidently been bestowed on the design and manufacture of the valves and the various connecting-rods, &c., which work them. All the bearing surfaces, for instance, are exceptionally large. The pins are made from case-hardened Yorkshire iron, and are held in place by cones and nuts, so as to facilitate withdrawal when necessary. Every bush, too—and all are of gun-metal—is adjustable by means of a wedge and bolt. In the same way all the connecting-rods are also adjustable. The rocking arms for carrying the excentric rods are made of cast steel, and their bosses are bushed with gun-metal. They rock upon large diameter shafts which, are case-hardened. The excentric straps, connecting-rod big ends, and main bearings are lined with white metal. As a result of the accuracy of the workmanship and proportions, the running is exceptionally noiseless, and very heavy changes of load under ordinary working conditions, amounting to perhaps as much as over 700 horse-power thrown suddenly on add off, make no appreciable difference as regards the sound. There is not a knock to be heard in any part.

The governors are belt-driven with two 3½in. belts each. Exception may be taken to this method as being much less reliable than direct driving, but in the present instance we understand that there has been no trouble. The governors, the form of which will be seen in the illustrations, are fitted with ball bearings. In addition to the ordinary working governors the engines are also provided with an electric knock-off arrangement as well as a separate governor for closing a throttle-valve in case of emergency. This safety governor, which is not belt driven, of course minimises the defect of the speed governors being belt driven.

Fig. 3—ARMATURE CORE

The electrical knock-off arrangement consists of a special relay connected across the dynamo terminals, an electro-magnet whose circuit is closed by the relay, and a trip catch in connection with the weighted lever of the throttle valve, which on closing cuts off the steam to the engine. The armature of the relay is adjusted to act only upon a predetermined rise of electrical pressure being exceeded from whatever cause; the circuit to the electro-magnet is then closed, when it releases the trip catch, so allowing the weighted lever to fall and close the valve. A switch is also fitted to allow of the closing of the electro-magnet circuit by hand.

On page 588 we give outline drawings of the engines, and on page 592 reproductions from photographs taken in the generating station.

Both engines work condensing and drive their own jet condensers. The condenser is in each case placed in a pit at the back of the low-pressure cylinder, and each has two vertical single-acting jet condensers driven by means of a bell-crank lever from the tail end of the piston-rod which is prolonged through a stuffing-box in the cylinder cover. The air pumps are made of Muntz metal.

The dynamo has twelve poles; the greatest outside diameter of the magnet frame over the circular part is 12ft. 8in. The internal bore of the magnets is 9ft. 8in. The whole magnet frame construction is of steel, and the magnet frame is in four quadrants. The width of the pole faces is 2ft. 3in. The magnet coils are partly in shunt and partly series, the compounding being such as to keep a straight-line voltage curve at the terminals. The hub of the armature is of cast iron, and is fitted with two end rings. The charcoal iron core is built up in the ordinary way, and held in position by the pressure of the end rings, and bolts passing through the end rings, and holes drilled and reamered in the core discs. The winding of the armature is composed of bars laid on in what is known as the barrel method, the connections to the commutator being taken down by copper strips, slightly curved. The commutator itself has a hub of cast steel, and is made in the ordinary way; the diameter is 4ft. 6in., and its face is 1ft. 2in. Current is taken off by means of 120 carbon brushes, ten on each stud. The weight of the armature complete with short piece of shaft is about 28 to 29 tons. The magnets complete weigh about 30 tons. We give reproductions from photographs of the field ring and armature without winding—see Figs. 2 and 3.

The switchboard for these sets is erected in a gallery overlooking the engine-room, and is divided into sixteen fitted panels of black polished marble, two panels for the generators, two for the booster motors, four for the feeder battery circuits, and eight panels for the ordinary feeder circuits, each being fitted with the requisite ammeters and volt meters, automatic cut-outs, and switches. The most novel portion of the board is the lever shutter switch, which has recently been brought out by John Fowler and Co. The switch is operated by pulling a lever, which, as soon as the contacts have broken, releases an insulating shutter, which instantly flies up and prevents an arc following the lever contacts. In putting the switch into circuit again when the lever is pressed forward it automatically lowers the shutter and allows the contact plugs to enter the sockets.

THE INSTITUTION OF CIVIL ENGINEERS.

The first students' meeting of the session was held at the Institution on Friday evening, December 7th, the President, Mr. James Mansergh, in the chair.

A paper on "Dock Gates" was read by Mr. F. K. Peach, Stud. Inst. C.E. The following is an abstract of the paper:—The entrance or passage to a dock is usually provided with at least one pair of water-tight gates to render the level of the water in the dock independent of the variation of the tide; gates of timber and iron are considered with reference to their respective advantages and disadvantages. The form of construction has gradually improved, and the old form of straight gate has been succeeded by the more modern forms of the Gothic arch and circular gates; the points of support of the gates, the quoins, sills, and gate recesses, mitre-posts, &c., are of importance. The gates at Dover Harbour—which are of the Gothic arch form—are described in detail. They are constructed of wrought iron, with the exception of the heel-posts, sills, and mitre-posts, which are of greenheart. They were erected in the year 1888, at the entrance to the Wellington Dock, when the entrance was widened from 60ft. to 70ft. The mode of working the gates and their maintenance is described. Repairs were recently carried out in connection with these gates; they were both removed from their pivots, taken away clear of the entrance and thoroughly cleaned; the sills, mitre and heel-posts were renewed, and several repairs were necessary for the stone facing for the sill, and also for the heel-post stone. The damage necessitating these repairs was chiefly caused by the swell in the tidal harbour against the outer face of the gates, which caused the closing chains to break. The paper is accompanied by several photographs of this work.

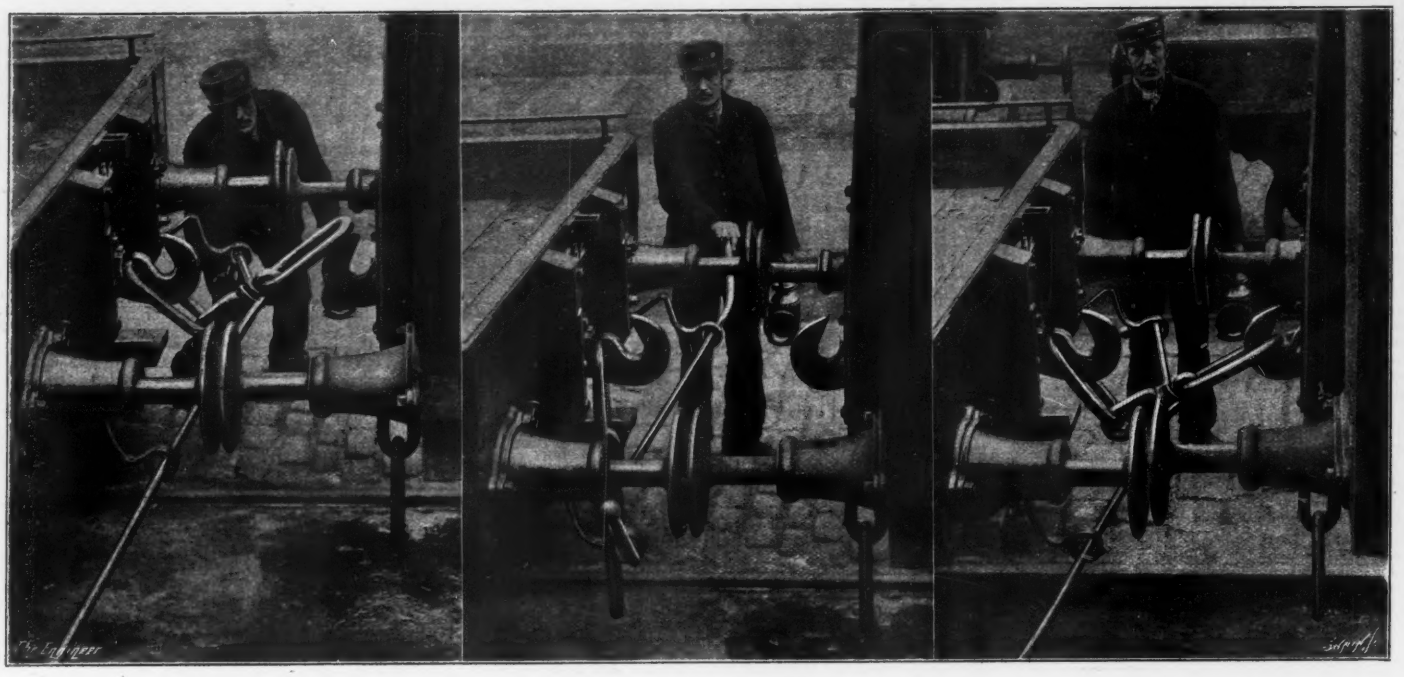
A discussion followed, in which Messrs. L. H. A. Shadwell, H. W. Fitzsimons, and C. E. Inglis, B.A., Studs. Inst. C.E., took part.

Steel Progress in the Southern States.—The world has heard a good deal of late about the rapid progress of the Southern States in the iron and steel industry. Men in the North are beginning to pay close attention to the possibilities of the other part of their country, whence arise rumours of large plants to be established. Most of these rumours are baseless or premature, but interest in the South is certainly spreading. The American Steel and Wire Company is credited with endeavouring to get a foothold there by the absorption either of the Tennessee Coal, Iron, and Railroad Company or the Alabama Steel and Wire Company. It is stated that a definite proposition has been made to the Alabama Steel and Wire Company to sell its rod, wire, and nail mill at Ensley, and it is further asserted that the acceptance of the proposition was not even considered. The rod mill has constantly enlarged operations ever since it started a year ago, and is now running day and night to fill the demand for its goods. Its trade in the South-West is particularly large, and it ships a good deal to Europe, making it a formidable competitor for the American Steel Company in this direction. Significant, also, is the announcement that an ex-president of the Carnegie Company—apparently Mr. Frick or Mr. Phipps—is to become chairman of the Tennessee Coal and Iron Company. This company has recently enlarged its works, and the growth of both its iron and steel and its coal business has enabled the directors to put the common stock on an 8 per cent. dividend, and following upon this, it has been determined to create a new office, so that the expanding business may the better be handled.

HILL'S WAGON COUPLING.

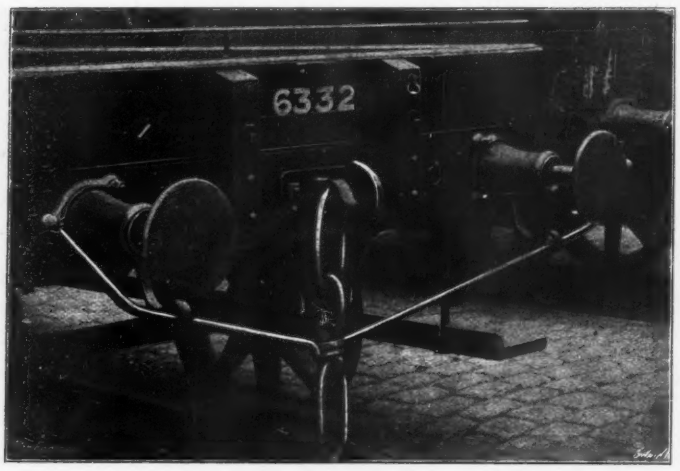
THE accompanying engravings will almost explain themselves to railway men. They illustrate a coupling invented by Mr. Hill, of 11, Victoria-street, which has been very favourably received by the engineers, traffic managers, and shunters of several leading railways, and with which some hundred wagons have already been fitted.

The broad principle is simply that of the shunting pole. Each wagon is fitted, so to speak, with four permanent shunting poles. It is not an automatic coupling. It can be fitted for quite a small sum to any wagon, and it interferes with no existing arrangement.



HILL'S SHUNTING POLE COUPLING

All wagon couplings consist of three links, one with a shackle. Mr. Hill takes the middle link, closes it in the middle, and wraps round the closed place, or neck, the ends of the shunting poles, as seen in the photograph. The poles are of thick tubing, with solid ends stuck in and secured with a cotter. The pole rests in a large eye made in a bracket bolted to the headstock, close to the buffer. The pole is bent at the end, and in this bend lies the secret of success. The shunter, by leaning on the bent end, twists the bar, and, at the same time, swings over and raises the link until it will drop on the hook of the wagon. The action is difficult to explain, but it can be learned in a minute, and wagons can be coupled and uncoupled with one hand with the greatest ease.



HILL'S COUPLING

The invention is simple to the last degree. The whole affair is rough-and-ready and cheap. It, beyond question, makes shunting as safe as any appliance can make it; and altogether it appears to be an extremely satisfactory solution of a considerable difficulty. We believe we are correct in saying that, the moment it has been passed by the Board of Trade, and the Railway Association, it will be largely put into use.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet engineers: T. Rule, to the Vivid, additional for the Temeraire; J. R. Pedrick, to the Cambridge, additional for the Conqueror; W. G. Parsons, to the Alexandra; W. H. Pibworth, to the Duke of Wellington for the Swiftsure; H. B. Rashbrook, to the Vivid, additional for the Bellerophon; T. Rule, to the Europa (lent). Chief engineers: T. R. Reynolds, to the Duke of Wellington, additional for the Glatton; J. T. H. Ward, to the Pembroke, additional for the Northumberland; W. F. Hinchcliff, to the Duke of Wellington, additional for the Iron Duke; G. W. Murray, reappointed to the Sylvia; W. G. Ludgate, reappointed to the Duke of Wellington. Engineers: R. W. Martell, to the Duke of Wellington, additional for the Violet; J. E. Moorshead, to the Victory, additional for the Vulture.

MEANS OF COMMUNICATION IN RUSSIA.

THE total length of the Russian railway system is far from being in proportion to the size of the empire, although a system which comprises in round numbers 50,000 kiloms. may claim to rank among the leading railway systems in Europe. While in France there are 1100 kiloms. of railway to every million inhabitants, there are in European Russia only 374 kiloms., and in Russia, in Asia, 432 kiloms. to the same number of the population. Again, in France there are 78½ kiloms. of railway lines to every area of 1000 square kiloms., in Switzerland there are 91·4 kiloms., and in Germany 87·6 kiloms. to the same area; in Russia there are only 7·7 kiloms. of railway to every 1000 square kiloms. From these figures it will be seen that if Russia is to be placed on the same scale of development with regard to its railway system it must possess not 50,000, but 500,000 kiloms. of railroad. In spite of the extension of Russian railways carried out of late in various directions, the *Sseverny Kuryer* upbraids Russia with having earned the title of "the country without roads."

Not alone is Russia, in comparison with its immense size, lacking in railway accommodation; there is also a greatly felt want of long standing with regard to highways and ordinary roads. It is somewhat strange that, while Poland is well and sufficiently supplied in this latter respect, in the rest of European Russia there are such roads only to a length of 12,048 versts, or 8032 miles, and it is becoming more and more apparent that the construction of highways and roads ought to have kept pace in a higher degree with railway construction. In the Petersburg and Moscow Governments, the length of made roads at present available amounts to 50ft. to every two-thirds of a square mile. This ratio decreases gradually until in eight governments there are only 6ft. of highway to the above area, and in fourteen Governments, that is, in the northern Governments, in many of the Volga Governments in south-eastern Russia, and in the territory of the Don Cossacks northwards of the Sea of Azov there are, generally speaking, no high roads. In Prussia there are 128 yards of high road to every two-thirds of a mile of the area of the country, and 666 yards in England. Thus, European Russia is far behind in this matter, and the inference is that the Imperial and local authorities have alike under-estimated the importance of providing well-made high roads. In fact, scarcely any new high roads have been built since 1864. It is true that the construction of new lines of railway may, to a certain extent, make up for the absence of roads; but the railways must be fed, and therefore a proper systems of roads is all the more indispensable, especially as the present railway accommodation in Russia is far from being commensurate with the size of the empire. The apathy of the authorities so far as road-making is concerned is counterbalanced in some measure by the fact that Russia possesses an admirable river system; for at least four months in the depth of winter the heavy snowfall permits the possibility of making tracks for sleighs in every direction, and in many cases without any regard to the beaten tracks followed by vehicles during the rest of the year, while the frozen surfaces of many of the great rivers are used as ways of communication.

ALMANACS, CALENDARS, &c.

WE have received from Thos. Robinson and Sons, Limited, Rochdale, a wall calendar, the leading feature of which is that the dates are arranged in groups of six working days, on tear-off slips, Sundays having been omitted.

LESSONS OF THE PARIS EXHIBITION.

THIS question was again under discussion by members of the Manchester Association of Engineers at their meeting held on Saturday, the president, Mr. Henry Hodgson, occupying the chair.

Mr. Vose observed that, as regards machine tools, continental engineers appeared to have grasped pretty well the leading lines, and any tools we sent over there would have to possess some special feature if they were to find a market.

Mr. J. Saxon remarked that a continental exhibitor expressed to him the opinion that one fault of English engineers was that they still stuck to the Corliss valve, and that if they would only take up the Colman or Sulzer valve they would "beat their continental rivals hollow."

Mr. Mellanby said he considered the continental marine engineers were not "in it" when compared with British engineers, not only as regards design and simplicity, but also as to price; and the vertical engines for electric light work that had been so much talked about were not comparable with the ordinary marine engine that any big firm on the Clyde or the North-East Coast would turn out every week; and he thought that stationary engine builders would have to look to those districts rather than abroad for the most formidable rivalry in the design of engines for such purposes. He might, however, say that the Diesel motor appeared to be far ahead, at any rate in principle, of the ordinary oil engine, and it was to be regretted that it had been left to continental engineers to forestall us in designing it. With regard to technical education he might point out that there was no lack of men in this country who had served five or six years' apprenticeship, and then attended a technical school for further education, and had a good knowledge of engineering, but they often had a difficulty in getting posts at anything like a reasonable salary, owing to a mistaken prejudice which many employers seemed to have against anyone who came from a technical college.

Mr. Joseph Nasmith reminded the members that, through the action of the Manchester Corporation Technical Instruction Committee, the important educational exhibit of the United States was being brought to Manchester, where it would be on view early in the New Year. He also pointed out that one of the lessons to be learned, particularly from the Americans, was that, however important it might be to design and manufacture, it was equally important to know how to sell.

Mr. Row thought that British firms had not paid sufficient attention to appearance in their exhibits. As to the Creusot marine engine, this had the appearance of complication, owing to its having to be kept within certain limits of space, but otherwise it was a really good piece of work from beginning to end.

The President remarked that, in his opinion, the British portion of the Exhibition in the metallurgical and mechanical line was very poor and small indeed, and included nothing to boast of except the locomotives and textile machinery. As to locomotives, the advantage was more apparent than real. One thing which gave the English locomotives a good appearance was that all the valve gear was inside, whereas in the foreign locomotives it was exclusively outside. The question then arose as to which was the easiest to get at, and of course the outside gear was the most accessible. In his opinion the Walschaert valve gear was better than the ordinary link motion, because it gave equal distribution at all points of cut-off. As to machine tools, with two or three exceptions, in which American ideas were adopted, there was nothing specially new or original in the English exhibits. As to stationary engines, he doubted whether the throttle and automatic cut-off could be successfully combined. There should, however, be no difficulty in a varying Corliss gear to control an engine when the whole of the load was thrown off. One great point about the foreign engines was the evidence they afforded of the attention that had been paid to every detail, and as an example of careful design and finish he might specially mention the engine shown by Carels, of Ghent. As to the best type of valve, they might be convinced that the Sulzer or Colman was preferable to the Corliss, but the difficulty would then be to persuade their customers to take the same view. He believed the purchasers of engines and tools in England were more to blame than engineers themselves, as they were not always willing to pay the price for a good thing, and looked rather for the lowest estimate of first cost rather than for something which would do the best and most economical work. With respect to the improved tool steel shown by the Bethlehem Company, however, although they were the first to introduce such a steel, still something had also been done in this country with a view of increasing the speed of tools. With regard to the education of the young engineer, we were a long way behind the Continent and America. As to the Creusot battleship engines, although they appeared complicated owing to the height and space occupied having to be kept down they were a very good type of engine. Mention had been made of the Diesel engines, and he might tell them that a company was being formed for manufacturing them in this country, and in this he was taking a prominent part. In conclusion, he might say that the show at Paris certainly would not lead the foreigner to believe we were in the front rank in engineering, and unless we looked to it we would ultimately be accounted not first, but a long way behind.

RAILWAY MATTERS.

ACCORDING to a despatch from Pittsburg, 6000 tons of steel rails have been ordered by the Great Eastern Railway of England from the Carnegie Company.

LAST month there were deposited twenty-seven applications for orders authorising the construction of light railways. Of this number eighteen of the lines are new, and the total mileage is 142¼.

THE Works Committee of the Beckenham Urban District Council are considering the proposed electric railway or tramway for the purpose of improving the communication between Beckenham, the Crystal Palace, and Croydon.

THERE appears to be some prospect of the Derby and Ashbourne light railway project being proceeded with, preliminary difficulties and differences concerning the mode of construction of the rails within the borough having been tentatively, at all events, settled.

OF the 138 railways in Canada, covering 16,000 miles, and owned by 74 companies, with a joint revenue of some £5,000,000, the Government at present owns only two—the "I.C.R." and the line on Prince Edward Island—with a mileage under 2000.

WHEN the Vera Cruz and Pacific Railway is constructed *viâ* Cordova, on the Mexican Railway, another means of communication between the Isthmus of Tehuantepec and the capital will be at the service of the public. Several miles of the Vera Cruz and Pacific Railway from Cordova, *viâ* Monzorongo, are already laid.

THE proposal to form a light electric railway connecting the village of Lyndhurst with Lyndhurst-road Station has so far progressed that application will be made in the ensuing session of Parliament for the necessary powers to carry out the project. The proposed railway would pass almost exclusively over forest land.

THERE are five railway companies in existence in Uruguay, of which the Central is by far the most important. There were, towards the end of June, about 1604 kiloms. open, of which 1149 kiloms. are guaranteed by the State. The minimum cost per kilometre appertains to the Central, viz., 27,925 dols. The traffic appears to remain about stationary.

THE number of accidents to trains on the railways of the United States in October was 257, by which 74 persons were killed and 176 injured. The accidents included 126 collisions and 127 derailments. A classification shows that 14 accidents were due to defects of road, 31 to defects of equipment, 79 to negligence in operating, 18 to unforeseen obstructions, and 115 are "unexplained."

THE directors of the South-Eastern and Chatham and Dover Railway companies have decided to apply to Parliament for powers to construct a new bridge across the Swale, an arm of the sea which divides the Isle of Sheppey from the mainland of Kent. The existing road and railway bridge at King's Ferry was built when railway communication was established with the Isle of Sheppey.

THERE has recently been a marked improvement in the time kept by the trains on the London and South-Western Railway into Waterloo Station, says the *Times*. Last week on Tuesday, Wednesday, and Thursday, 85·38 per cent. of the trains were to time. Trains arriving from five minutes to one minute before time were no less than 89 on Tuesday, 62 on Wednesday, and 74 on Thursday. On Friday and Saturday, in consequence of race meetings, the result was not so good, but all the business morning trains were punctual.

THE North-Eastern Railway Company disclaims any idea of racing from London to Scotland. It has no intention of reaching Edinburgh before the booked time, 6.15 p.m., and explains that recent late arrivals have been caused by floods, which have almost entirely stopped the traffic on their main line to the North, necessitating its diversion to a somewhat circuitous route, not suitable for fast running. It is expected that the main line will soon be in proper working order, and then there will be no difficulty in running the train according to scheduled times.

AMONGST the railway Bills to come before Parliament during the 1901 session is one for power to construct a line connecting by tunnel under the Solent the London and South-Western Railway, at a point near Lymington, with the Freshwater, Yarmouth, and Newport Railway at Freshwater, in the Isle of Wight. The tunnel, says the *Railway News*, will be of a size to take the ordinary stock of the South-Western Railway, and constructed in the usual manner, with brick and cement, other than about the middle portion, which will probably be constructed similar to the electric railways in the metropolis. It is understood that the character of the soil to be penetrated is favourable to the enterprise.

THE Norwegian Government has asked the Storthing to grant the necessary funds for a detailed survey of another railway link between Norway and Sweden, which would eventually make the fourth railway between the two countries. The line is to run from Elverum, in east-central Norway, *viâ* the great timber-producing district of Trysil, and across the frontier into the rich province of Dalcarlia, whence there is direct railway connection with the important ports on the Baltic. This line is worked by the Mord-Venern Railway Company, which is taking part in carrying out the scheme. It is anticipated that the new line will be of great importance to the Norwegian timber industry in the central parts, through export from the Baltic, and an expert who has been commissioned to provisionally survey the Norwegian section reports that it offers no great technical obstacles, even to a heavy timber traffic.

THE construction of three new railways is proposed in Poland. These lines are first, from Kholm in the province of Lublin through Oukhané, Neledov, and Grubeshov to Krylov, with two short branches, one from Grubeshov to Strijeva, and the other from Krylov to Mirtché. The cost of construction of the line, which is to have the normal gauge of 5ft., is estimated at 2,500,000 roubles. The second line will be of narrow gauge, and will start from the Mekhov Station on the Ivangorod-Dombrovo Railway, and will pass through Kalina, Velka, Dzialoschitsé, Skalmerj, and Kazimerj, terminating at Proschovitsé, with branches to Loubno and Shreniava, where there are sugar refineries. The total length of this line will be 67 versts, and it is proposed to form a joint stock company with a capital of 2,400,000 roubles to undertake its construction. The third line, which it is proposed to construct on the narrow gauge, will connect Schidlovetz with Prjissoukha, with branches to Yanov and Kouznitsa, the total length being 36 versts.

TWO derailments which have occurred recently on the Siberian Railway are a further proof, if any were needed, that the line has been too lightly constructed to enable it to carry the heavy locomotives now running on it, to say nothing of the ever-increasing goods traffic. The first derailment referred to was caused by a "burst rail," and, of course, until the entire line has been relaid with heavier and sounder rails, there will be always the risk of other "burst rails," causing loss of life and interruption of the traffic. The second accident, which is the fifth of this nature on the new line, shows that the supervision exercised over the traffic is far too weak. The control of the line is in the hands of one man, while the general management is not on the main line, but on one or other of the branch lines. Both the people and the Press of Siberia have come to the conclusion that to ensure the proper working of the line in the best interests of the country, the Siberian Railway ought to be divided into three or four separate and independent sections.

NOTES AND MEMORANDA.

THE gold yield of Victoria for the last eleven months amounted to 724,909 oz.

DURING the last ten years the amount of coal mined in India has increased from 2,168,500 tons, to 4,937,000 tons in 1899—a growth of 128 per cent. The production of iron amounted last year to 60,700 tons.

ACETYLENE may be liquefied at 97 deg. Fah. by a pressure of 68 atmospheres, or at 68 deg. Fah. by a pressure of 42·8 atmospheres. In this state one volume of liquid acetylene will produce 340 volumes of free gas.

A NEW sewerage system is being provided at Vera Cruz. The work is being carried out by S. Pearson and Son. The sewage will be pumped into deep water out at sea. New waterworks are also under consideration, and the tramways are to be converted for the use of electric power.

AT one of the coal borings in the Pas de Calais a crown, of the value of £800, was worn out after having made a hole only 32ft. deep. This quick wear is due not only to the extreme dryness of the strata, but, above all, to its small degree of cohesion; so brittle is it, the small fragments and pieces of the rock break off and become jammed between the crown and the walls of the boring, and this tends to loosen the diamonds, and thus the crown is worn out in a very short time.

ONE of the largest chimneys in New York State, and probably in the country, has just been completed at the new power station of the Schenectady Locomotive Works. The chimney is 200ft. in height, and is 32ft. square at its base. For nearly 40ft. it rises perpendicularly, and then assumes an octagonal form and gradually batters to 16ft. in diameter at the top, where it flares, and is surmounted by an iron cap 3ft. high. The flue is 10ft. in diameter. About 600,000 tons of brick were used in its construction.

FROM the commercial statistics of Switzerland for 1899 just published, it appears that the output of watches in that year was the largest ever recorded, and that about 20 per cent. of the whole manufacture was exported to the United Kingdom. The total exports to all countries comprised 2,366,426 nickel watches, value £812,800; 3,086,770 silver watches, value £1,515,240; 800,258 gold watches, value £1,622,920; 6769 chronographs and repeaters, value £52,160; total 6,260,223; value, £4,003,120.

THE quantity of gold and platinum extracted from the Oural deposits continues to decrease steadily. According to information furnished by the Office of Mines for the Oural District, the quantity of gold extracted during the first eight months of 1900 amounted to 374 pouds 20 livres, a decrease of 56 pouds 18 livres on the corresponding period of the previous year. The quantity of platinum extracted was 217 pouds 15 livres, as against 252 pouds 8 livres for the first eight months of 1899. A poud = 36 lb. (avoirdupois).

DURING November English shipbuilders launched 34 vessels, of about 106,927 tons gross, against 19 vessels, of 54,924 tons gross, in October; 24 vessels, of 76,494 tons gross, in November last year; 26 vessels of 72,604 tons, in November 1898, and 14 vessels of 34,681 tons in November, 1897. For the eleven months English builders have launched 253 vessels, aggregating 701,160 tons gross, comparing with 277 vessels, of 780,148 tons, in the corresponding period of last year, 311 vessels, of about 780,315 tons gross, in 1898, and about 530,030 tons in 1897.

A REPORT by the Board of Trade on their proceedings under the Weights and Measures Acts has been issued. It states that the Board have been asked to approve the use of avoirdupois weights of the following denominations:—50 lb., 25 lb., 10 lb., and 5 lb., being aliquot parts of the "cental" of 100 lb. The series of avoirdupois weights at present in use includes: 56 lb., 28 lb., 14 lb., 7 lb., and 4 lb.. and after careful inquiry it was held that the concurrent use in trade of two series of weights would lead to confusion, and might facilitate the commission of fraud.

ACCORDING to the report on the condition of the metropolitan water supply during the month of October, made by the Water Examiner appointed under the Metropolis Water Act, the average daily supply delivered from the Thames during the month was 119,499,784 gallons; from the Lea, 42,406,973 gallons; from springs and wells, 49,566,584 gallons; from ponds at Hampstead and Highgate, 1925 gallons. The daily total was, therefore, 211,475,266 gallons for a population estimated at 6,150,102, representing a daily consumption per head of 34·39 gallons for all purposes.

DURING the year ended June 30th last 24 persons were killed and 65 injured by boiler explosions in the United Kingdom. The average number killed and injured during the last eighteen years were 29·2 and 61·5 respectively. The number of preliminary inquiries held during the year, under the provisions of the Boiler Explosions Acts, was 59, and in 13 cases formal investigations followed. In 28 cases the boilers which exploded had been inspected on behalf of insurance companies, classification societies, or in connection with the survey of passenger steamships, but in ten of these cases the explosions were not due to defects in the condition of the boiler.

ACCORDING to a writer in an American electrical paper, the electric arc furnishes the best means of cutting through pieces of structural iron and steel such as girders. For successful sawing of structural steel, a current of not less than 350 ampères should be used for quick working. The arc carbon should be about 1½in. diameter, and connected to the negative side of the circuit. A heavy aluminium band bolted round the carbon, and framed in a wooden handle, has been found the best method of holding the carbon. To steady the current, a length of No. 18 German silver wire, sufficient to absorb all but 70 volts or 80 volts at the required rate of current flow, wound on a wooden frame and immersed in a pail of running water, is usually employed. The cutting is rough and jagged.

WE learn from an American contemporary that a new kind of wooden pipe has been introduced by a company at Spokane, Washington, U.S.A., and been put to practical use in that district. This new pipe is made like the Wyckoff pipe, in standard lengths, but instead of being cut out of a solid log in one piece, each length is made up of staves wound with galvanised steel wire under tension. The sizes made are 2in. to 8in. internal diameter. The staves are kiln-dried Oregon fir, ⅞in to 1½in. thick. Joints are made with a male and female socket on the small sizes and a sleeve and butt joint on the larger sizes. Some 8in. pipe of this sort wound with No. 4 copper wire has been tried in mines, where the acid water rapidly destroys ordinary iron pipes, and with excellent results. This pipe has been tested to 500 lb. pressure.

UP to the present not one of the thirty attempts to win coal in the south of the Pas de Calais coal basin has met with much success, although at some places the boring has been carried to a depth of 1950ft. The collieries of the Pas de Calais exploit the coal at a depth varying between 975ft. and 1135ft., a fact that leads one to doubt whether the majority of the borings in existence will ever yield any profitable result. The strata of Pas de Calais is extremely dry, and on this account progress is exceedingly slow, falling in of the bore, as well as breakage of the rods, being frequent. The strata is of the Devonian formation, covered by chalk and marl. Diamond boring has been employed in three different instances at depths varying from 975ft. to 1300ft., but it has been necessary to abandon this method, says *Boring and Drilling*, because of the great rapidity with which the diamonds wear out.

MISCELLANEA.

ACCORDING to the *Frankfürter Zeitung*, the firm of Edrhardt, of Eisenach and Düsseldorf, is supplying England with eighteen batteries of quick-firing guns, 900 ammunition wagons, and 54,000 cartridges, in execution of a contract made with the Chartered Company last April.

A NEW White Star Liner, the Suevic, was launched from the yard of Harland and Wolff, at Belfast, last Saturday. She is identical in dimensions and tonnage with the Runic, which was launched in October and which is to be despatched on her first voyage on January 3rd. She has a length of 565ft., a breadth of 64ft., and a gross tonnage of 12,400 tons.

AT an important meeting of Spanish capitalists held at Cadiz lately, it was decided to re-organise the Spanish Naval Construction Company, for the purpose of establishing an extensive shipbuilding yard at Cadiz. The company is also to undertake the manufacture of agricultural and other machinery. For the purpose of supplying pig iron, smelting furnaces are to be erected.

OUR South Wales correspondent writes:—"Intelligence has just been received to the effect that the Abertillery tin-plate works and the Waterloo tin-plate works offered for sale at Tokenhouse-yard, London, by Stephenson and Alexander, under an order from the High Court of Justice, failed to get a purchaser. No bids were made, though the attendance was large."

A MEETING of Midland cycle manufacturers was held at Coventry last Friday to protest against the War-office specification for a number of bicycles for which tenders had been invited. The machines were for Natal, and it was specified that a certain firm's fittings should be used. The War-office admitted that the tender was not according to instructions, and that it would be amended so as to allow manufacturers to make their own parts for the bicycles.

WE understand that negotiations are practically completed by which the Moss Bay Iron and Steel Company, Workington, will acquire the concern of Sir James Bain and Co., at Whitehaven, and other places in West Cumberland. The change proposed is one of the most important that has taken place in the district for many years. Bain and Co. lease the Earl of Lonsdale's collieries at Whitehaven, besides being interested in other important concerns in the district.

THE steamer Dunstan was docked at Greenock this week, with over 3000 tons of steel plates and angle steel for local shipbuilders. The steel is from Carnegie's Works, and was shipped at Philadelphia This is the first full cargo of American manufactured steel to reach the Clyde. Other two cargoes are on their way here. Notwithstanding the railway freight to Philadelphia, and the ocean freight, the steel has reached the Clyde 10s. per ton cheaper than the present home prices.

THE Danube-Save Canal, which the Hungarian Government proposes to construct, is for the purpose of providing a short and cheap route for the transport of bulk freights to Fiume. The canal will run from Vukovar on the Danube to Samac on the Save, and will have a length of 57½ kiloms. The distance between these two points by the natural waterway is 479 kiloms. From Samac it is intended to make the Save navigable as far as Sissek, a distance of 288 kiloms. From Sissek the route will be continued to Karlstadt, a distance of 135 kiloms., by making the river Kulpa navigable between these two points. From Karlstadt to Fiume will be by rail.

H.M. NEW twin-screw war sloop Espiègle was launched from the building slip at Sheerness dockyard on Saturday. The Espiègle is a sloop of 1070 tons displacement. She will be fitted with engines supplied by the Wallsend Slipway and Engineering Company, and estimated to indicate 1400 horse-power, and to propel her at a speed of 13 knots to 13¼ knots per hour. Her boilers are to be of the Babcock and Wilcox water-tube type. Her armament will consist of six 4in. quick-firing guns—two being mounted forward, two aft, and two amidships—four 3-pounder Hotchkiss guns, and two ·45in. Maxim guns. She has a length of 185ft., a breadth of 33ft., a mean load draught of 11ft. 3in., and a displacement of 1070 tons.

IT is stated authoritatively that Naval-Constructor Francis T. Bowles will be appointed chief constructor of the United States navy on the retirement for age of Chief Constructor Philip Hichborn on March 4th next. Constructor Bowles is fourth in the list of constructors with the relative rank of captain. He entered the naval academy in September, 1875, from Massachusetts. Since August 1st, 1895, he has been in charge of the construction department of the Brooklyn navy yard. While at the Norfolk navy yard, in the 80's, he superintended the construction of the battleship Texas, and when complaints were made that the vessel would be unstable, staked his professional reputation to the contrary and was triumphant. As chief constructor Mr. Bowles will have the rank of rear admiral.

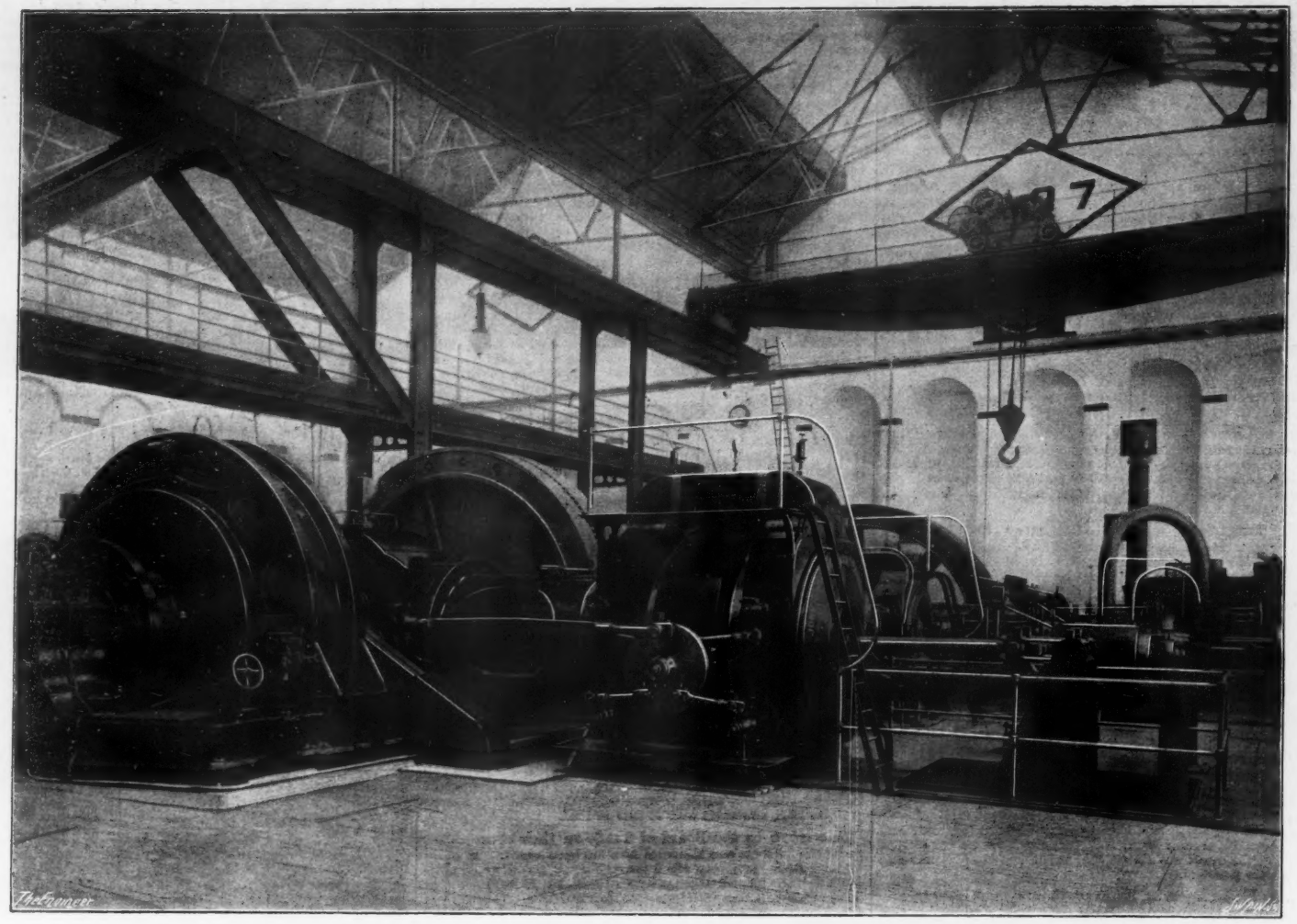
OWING to the enormous increase in the river traffic at Budapest recently, it is proposed to construct a commercial harbour in close proximity to the capital, somewhat on the lines of the docks of the Manchester Ship Canal. The plans have been well considered. There will be three basins with a minimum depth of three metres from the lowest watermark. The quays—of stone—will be of sufficient width to permit the erection of large warehouses and grain elevators, as well as the laying of a double line of rails for carrying big cranes. Electricity will be employed as the motive power for the cranes and all other mechanical appliances. In connection with the harbour a large goods and coaling station is proposed, and in addition, one and a-half million square metres of land will be reserved for the erection of factories. Each plot of ground will be situated in such a way that factories built thereon will have a water frontage and a rail connecting their warehouses with the Hungarian State Railways.

CONSIDERABLE interest will attach to the transporter bridge which is about to be erected, with parliamentary sanction, over the Manchester Ship Canal and the river Mersey, so as to connect the towns of Widnes and Runcorn. It will have a single span of 1000ft., and will be of the suspension type, having steel cables stiffened by two longitudinal girders, braced horizontally to withstand the wind pressure. A frame on rollers will run on four lines of rails, attached to the underside of the girders, and from this frame will be suspended a transporter car, to be moved to and fro by mechanical power. The car, in which covered accommodation will be provided for passengers, will be about 55ft. long by 24ft. wide, and will be very conveniently available for passengers, carriages, and wheel traffic of every description, and will be capable of accommodating at one time four two-horse farmers' wagons loaded with produce and 300 passengers.

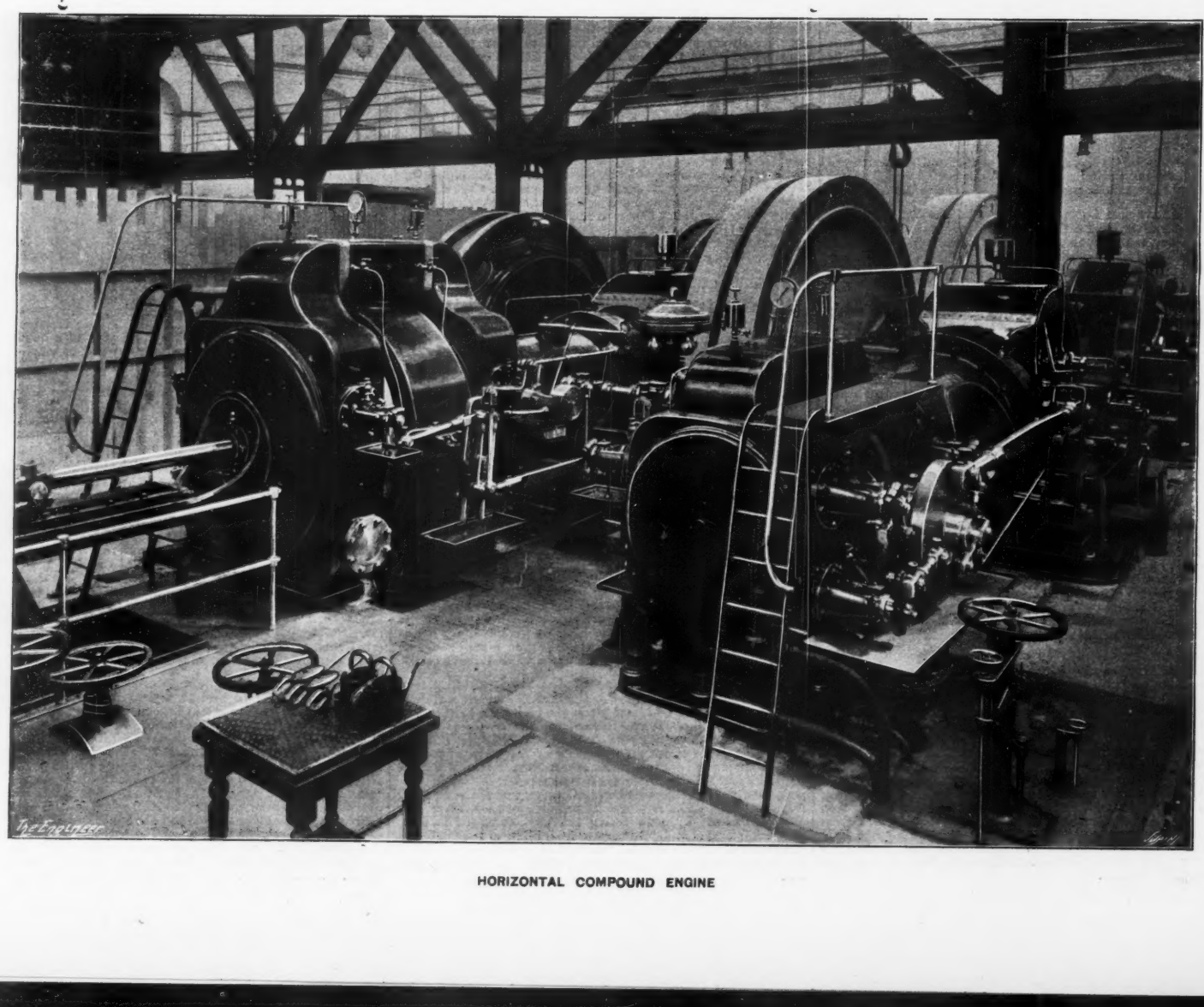
A MEETING of gentlemen interested in the revival of Cornish mining will be held at Winchester House, Old Broad-street, E.C., on Tuesday next, at 12 noon, when the following resolution will be submitted:—"That it is desirable to form a Chamber of Mines under the name of the London and West Country Chamber of Mines, having for its first objects, *inter alia*:—(*a*) To make known to mining investors the merits of the mineral deposits of the West of England. (*b*) To keep before the public the doings of the chief 'productive' and 'progressive' mines. (*c*) To answer the queries of subscribers in relation to such mines, and to warn them against such enterprises as seem to be of a bogus character. (*d*) To advise and recommend such general enterprises as water trusts, drainage plans, &c., with a view to the exploration and development of extensive mineral areas." The honorary secretary (*pro tem.*) is Mr. J. H. Collins, 14 and 15 Broad-street Avenue, London, E.C.

LEEDS TRAMWAY GENERATING PLANT

(*For description see page 589*)



ENGINES AND DYNAMOS



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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.*

REPLIES.

A. L. (Balham).—Address, 5, West Fifty-first-street, New York, U.S.A.

S. C.—Write to the Engineer-in-chief, Tramway Offices, Wellington, New Zealand.

CYCLIST.—The rubber solution used in the pneumatic tire manufacture is, or should be, composed of masticated Para rubber and coal-tar naphths.

BORING.—We shall be happy to aid you if it is in our power, but your position is unfavourable. We fear the trades union will always stand in your way.

F. W. C. (Gloucester).—The Kalka-Simla Railway is now under construction. The secretary's office is at 17, Victoria-street, London, S.W. The office of the Central-Argentine Railway is at 85, Palmerston-buildings, London, E.C.

BILLET.—The Wigan Coal and Iron Company is the chief Lancashire maker of billets which quote on the Manchester market. The only other important Lancashire maker is the Barrow Company, but it scarcely competes on the Manchester market, as the cost of carriage is too great.

IONOTO.—The words "horse-power cylinder," appearing in a daily contemporary, to which you call attention, supply no evidence of editorial turpitude such as you suggest. It is very obviously a misprint, or a misreading of a shorthand writer's notes for "high-pressure cylinder."

J. P. M.—Your explanation is very old. It is, however, chemically impossible that hydrogen should be set free in a boiler and subsequently exploded. There is quite energy enough available in the heated water in the boiler to do all the work of destruction. The only question is the precise way in which it acts.

S. M.—Gearing of all kinds represents loss of power wasted in overcoming the friction of the gearing. Numbers of ships have been fitted with gearing for driving screw propellers. That method of driving was the first adopted. Paddle-wheels were at first almost always driven by gearing. You are wasting your time in scheming mechanism of this kind.

AN ENGINEER (Calcutta).—The total weight of mountings per ship is 833 tons for the old and 907 for the new. The former, represented by the Royal Sovereign:—Four 13·5in. 67-ton guns in mountings without shields; the latter by the Duncan class:—Four 12in. 51½-ton guns and mountings with shields. The two complete shields weigh 280 tons together; the powder charge for the old guns was 630 lb., the cordite charge for the new 167 lb.

G. D. (Hoboken).—We do not know of any better journal to recommend than THE ENGINEER. It is our endeavour to keep in touch with all branches of mechanical engineering, and in our pages you will find drawings and illustrations of all notable developments in that direction. In French you have the *Revue de Mecanique*, very good in its way, and in German the *Zeitschrift der Vereines Deutscher Ingenieure* holds an almost unique position in journalistic literature.

J. P.—There is no special treatise on the management of manganese or any other bronze. The composition of all the copper alloys has settled down into a matter of trade secrets, and purchasers are supplied with information as to the best methods of working the metal. But no outsider is competent to write a general treatise on the subject, and for obvious reasons no one in the trade will do it. The firm from whom you buy your bronze will tell you all about it. We cannot suppose that you propose to make bronze yourself.

S. D. (Crewkerne).—The material required is not "silicon," but high silicon pig iron, the so-called "ferro-silicon" which is added to foundry mixtures in such proportion that missing silicon which has been burnt out in previous meltings is restored, and with it the greyness of the metal. Ferro-silicon is made at—among other ironworks—Govan, at Glasgow, and Ayresome, Middlesbrough. The latter firm—Gjers, Mills, and Co.—published a statement with some examples showing its use, which can probably be got on application. The most detailed series of experiments published are those of Mr. T. Turner in the *Journal* of the Iron and Steel Institute some years back.

INQUIRIES.

ROSEBANK BLOWER.

SIR,—We should be much obliged to any reader who could give us the name of the makers of the Rosebank blower.

Blackburn, December 6th. E. H.

MEETINGS NEXT WEEK.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, December 20th, at 8 p.m., at the Institution of Civil Engineers, Great George-street, Westminster, S.W. Lecture, "On the Electrical Engineers (R.E.) in South Africa," by Lieut.-Col. Crompton, E.E. (R.E.), Past-president.

SOCIETY OF ARTS.—Monday, December 17th, at 8 p.m. Fourth Cantor Lecture on "Electric Oscillations and Electric Waves," by Prof. John A. Fleming, M.A., D.Sc., F.R.S.—Wednesday, December 19th, at 8 p.m. Ordinary Meeting. Paper, "The Siege of Ladysmith," by Mr. W. T. Maud (special artist to the *Graphic*).

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, December 19th, at 7.30 p.m., at the Institution of Civil Engineers, Great George-street, Westminster. Papers, "The Seasonal Rainfall of the British Isles," by Mr. Henry Mellish, F.R. Met. Soc.; "A Review of Past Severe Winters in England, with Deductions therefrom," by Mr. Albert E. Watson, B.A., F.R. Met. Soc.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, December 18th, at 8 p.m. Papers to be discussed, "The Signalling on the Waterloo and City Railway," and "Note on the Signalling of Outlying Siding Connections," by Mr. Alfred Weeks Szlumper, M. Inst. C.E.; "Signalling on the Liverpool Overhead Railway," by Mr. Stephen Butler Cottrell, M. Inst. C.E. Papers to be read, "Glasgow Bridge," by Mr. B. Hall Blyth, M.A., M. Inst. C.E.; "Railway Bridge over the Fitzroy River, at Rockhampton, Queensland," by Mr. W. J. Doak, B.E., Assoc. M. Inst. C.E.; "The Niagara Falls and Clifton Steel Arch Bridge," by Mr. L. L. Buck, M. Inst. C.E.—Friday, December 21st, at 8 p.m. Students' meeting. Paper, "The Use of Geometrical Methods in Investigating Mechanical Problems," by Mr. C. E. Inglis, B.A., Stud. Inst. C.E.

DEATH.

On the 4th inst., at 26, Russell-road, Kensington, JOHN WILLIAM HART, M.I.C.E., late of Shanghai, aged sixty-three years.

THE ENGINEER.

DECEMBER 14, 1900.

NAVAL ENGINEERS.

IT was not our intention to interfere in the interesting correspondence now proceeding in our pages until such time as those taking part in it had formulated their views, and the solid matter had crystallised out of the mother liquor of words. It has become clear, however, that misapprehension exists as to the position we have taken, and that a few words of explanation are necessary; while it is desirable that our correspondents should have the limits of useful discussion at least indicated to them.

In the first place we wish it to be perfectly understood that while we have placed before our readers the heads of two general schemes, we are in no sense responsible for either of them. We have endeavoured to collect and put into something like a workable shape various suggestions which have been made public in various ways and in various places during the last few years or months. It will be remembered that the first of these schemes contemplates the supersession of the present naval engineer by men holding warrant rank, whose qualifications would be about equivalent to those of a man who possesses a Board of Trade chief engineer's certificate. These men would be under the command of a captain of engineers, with executive rank; the captain of the ship being of course in all respects as now, supreme. The engineer captain would maintain discipline in his own crew, and, being a man of high professional attainments, would be competent to advise in all cases of difficulty, and to deal generally with such questions as the consumption of fuel, the economy of steam, and so on. But the man in charge of the machinery of the ship, and directly responsible to the engineer captain, would hold the title of chief engineer, yet, as we have said, only with warrant rank; and in order that complaints and grumblings should be laid at rest, and the best men obtained, the pay should be very liberal, and the pensions good. For example, £50 a month would not be too much for a chief engineer, with suitable additions for prolonged service. The second scheme contemplates the supersession of the present executive, or "sailor," element by engineers. It is merely a development of the system now being tried in the United States navy. We repeat here that we do not at present express any opinion in favour of either the one scheme or the other. But they are both well worth discussion; and it seems to be pretty certain that either something very much like one, or very much like the other, will be adopted perforce in our Navy before many years, or, perhaps, months, have passed. It will be easily understood that we can set forth arguments in favour of either or both schemes without personally endorsing the one or the other. We may, however, go so far as to say that both are better than the existing system, which gives no satisfaction to anyone.

We may now proceed to say something about the correspondence which is proceeding in our pages. It will be seen that we have two contending parties. On the one side the naval engineer, on the other side the mercantile engineer. The discussion has mainly taken the form of a dispute as to whether the naval engineer or the mercantile engineer can best manage the machinery of a warship, and use it for the purpose for which it was made. It has been hinted that we ought to confine the correspondence to a discussion on the position of the naval engineer and the means of improving that condition. We venture to say, however, that this is not our main purpose in opening our columns to the correspondence in question. Our object is to promote in every way the efficiency of our Navy; and to that end to consider what is the best staff to work the machinery of our ships. The Navy first; engineers next; and we feel certain that the engineers will themselves be the first to say as we say. Indeed, a very legitimate contention, not only of theirs but of ours, is that the more happy and contented the engineers can be made the better for the Navy and all the mighty interests which it represents. It must be admitted that so far the naval engineers have failed to prove that the duties they perform could not be done by mercantile engineers; that is to say, so far as machinery is concerned. They argue that there are special duties peculiar to a man-of-war which they have to perform, but they do not set these out clearly. Take, for example, the statement made by a Fleet Engineer, whose letter we have not space to publish this week, that the work is done by three or four junior engineers in a battleship, assisted by a dozen artisans. Now, in a big merchant steamer there would be a dozen engineers instead of the artisans, and they would do what had to be done, and they would do it better and with more intelligence than fitters. So far there is nothing that we can see special to the naval engineer. Next we learn that when ships are manœuvring much vigilance is required; but we do not see what the engineer, who is below, has to do with this. So long as he obeys the telegraph promptly, he has done all that any engineer can do. When we come to naval discipline, drill, and such like, we are on different ground; but even here we do not see that there is anything that warrant officer engineers could not comply with. We are now pointing out the weak points in the case of the naval engineer, in the hope that, in order that the discussion may be instructive and satisfactory, some clear and definite information may be supplied which will show conclusively that the present system of training engineers for the Navy is the only satisfactory system; that the education cadet engineers receive is the best possible for the end in view; and that, in short, the existing Admiralty methods of supplying engineers to the Navy is so good that no change is desirable. It is absolutely necessary that the naval engineers should maintain this thesis. If they do not they will give their case away altogether. For men like our correspondent "Fidley House" maintain that the naval engineers now in our ships know at once too much and too little. They are so well educated that they resent the position and standing assigned to them. They are so far "gentlemen" that they are above the dirty and monotonous work of engine driving; and they are, as a class, deficient in that special knowledge which is possessed in the highest degree by the best men in the mercantile marine.

It is unfortunate for those who believe in the present system that so many of our ships have broken down. We are told that the Admiralty is to blame. "Chief Engineer, R.N." points out that high pressures and water-tube boilers have been thrust into the Navy so quickly, that there has been no time to learn how to use them. But, we may ask, in the first place, who is responsible for this but the

engineer advisers to the Admiralty? and, in the second place, although some four years have elapsed since the Belleville boiler came into fairly extended use, there is as yet no evidence of any radical improvement having taken place in its management. These facts are very hard to get over, and they greatly strengthen the hands of the mercantile marine. For ourselves, without taking sides with either party, we have before us the patent fact that engineering in the Navy is very far from being an unqualified success. It was not a success in the little navy of the United States, and Congress made a sweeping change in the position of engineer officers. It is vain, with the facts of the South African War before our eyes, to assert that all is as well as possible with our Navy. Precisely that was said of our War-office, of our guns, of our army. The repeated breakdown of machinery and boilers is a standing menace to the country. Those who are most in favour of the existing *régime* admit grave defects. Why, for example, should contractors' trials be run with a double engine-room staff, as stated by one correspondent? Do any of our ships carry the proper complement of engineers? For the twentieth time we point out that we do not blame men. We do not blame machinery. We blame a system. If it can only be shown that the one thing needful to make our Navy all that it ought to be is to give executive rank to the engineers, heaven and earth should be moved to get it for them. We fear, however, that the evidence available to prove that executive rank would cure all evils is far too weak to enable us to place much confidence in the proposed change.

NAVAL SUGGESTIONS.

It is not possible at the present moment to do more than refer very briefly to the excellent paper read by Admiral Hopkins on Wednesday last at the Royal United Service Institution. The paper was entitled "A Few Naval Ideas for the Coming Century," and its object was apparently to epitomise our knowledge of naval matters, and to draw from our past experiences suggestions for the future. In a large measure it dealt with subjects which are almost outside the scope of The Engineer. The advocacy of the provision of "a sufficient and efficient reserve" is a case in point. It is a subject, the importance of which we feel, in common with all others who interest themselves in our first line of defence, very keenly, but except as regards the engine-room staff of our warships, we should be intruding upon other people's affairs were we to enter upon a discussion of it here. With respect to the Admiral's suggestion that workmen in our large manufacturing towns should be invited to volunteer for reserve service, we may say that we feel fairly confident that there would be little difficulty in recruiting such a force from, at any rate, private dockyards and shipbuilding and marine engine works. We believe, too, that on account of the training which such men receive, they would be found of inestimable service in a time of stress. The question of the provision of stokers is not so readily answered, and the necessity for some months of training to enable men to get satisfactory work out of the modern type of boiler adds to the difficulty of suggesting a practicable plan. But it is the unattractiveness of the work that constitutes the main stumbling-block, and will, we fear, be a permanent obstacle to an efficient volunteer reserve for the stokehold. As far as the Admiral's suggestion for the creation of a reserve of naval volunteers, may be taken to refer to volunteer gunners, we are entirely in accordance with him. Surely it would be at least preferable to have a force to fall back upon in emergency, half-trained in the use of guns, than entirely untrained men. When the emergency comes there will be no time to train the raw material. We may say that the experience of the United States in this respect is entirely favourable to this view. Our views on the conferring of executive rank upon engineer officers are too well known to need emphasis in this connection; we cannot, however, refrain from congratulating ourselves that the cause with which we have associated ourselves should be strengthened by the able advocacy of an officer in her Majesty's Navy holding such an eminent position as Admiral Sir John Hopkins occupies. With his contention, too, that the "handy man" should be given a mechanical training to fit him to work in the stokeholds or to assist the regular staff detailed for the maintenance and repair of machinery and ordnance, we are heartily in accord.

On the subject of material, the address introduced such problems as the speed of war vessels and the size of battleships, points which we from time to time discuss, but which open too large issues for debate at the present moment. The Admiral's words are, however, worth producing, as, whatever the views of certain writers may be, his views appear to us not unlikely to be realised in all points, whilst there can be little question that if the fulfilment of certain of them is not seen our direction will be retrograde. Sir John Hopkins hoped that "the century now dawning will be rich in producing further developments, and that neither in speed, armament, coal endurance, nor general capacity, shall we see anything but general progress in each new class designed." Dealing with the all-important matter of the provision of coal, he suggested that the old idea of sailing colliers might be put on its trial. Such vessels, whilst fulfilling their specific function of providing coal wherever the fighting ships might require it, might at the same time be utilised to teach pure seamanship, and by mounting a couple of 6in. quick-firing guns on them, some training in this direction might also be afforded. Besides such sailing vessels, fast steam colliers to accompany the fleet, and condensing ships, should also be constructed, and he advocated also the provision of special steamers for carrying relief crews, which in war or other emergency could be rapidly converted into hospital ships. All these suggestions seem worthy of the closest attention. The paper concluded with an outline of certain manœuvres designed to prove the efficiency of the fleet, and the expressions of a hope that "as early as practicable in the next century we may possess 60 battleships of a homogeneous type, none of them older than the Royal Sovereign, supplemented by their proper proportion of cruisers and auxiliaries."

The address was a masterly exposition of a perfectly definite policy, and as such it affords basis for discussion on well defined grounds. We shall be in no small measure surprised if it is not used as a powerful weapon to break the last chains of inertia and precedent which still bind the navy of Great Britain.

THE COST OF SHIPBUILDING IN AMERICA.

As we anticipated some little time back, the question of shipbuilding subsidies has taken a prominent place in the business of the new session of the American Congress. Almost the first thing the Senate did when it met on Tuesday week was to take up the Shipping Subsidy Bill on the motion of Senator Frye, the protectionist gentleman who has made this matter peculiarly his own, and who on this occasion made an elaborate speech in which he declared, according to the cable message sent over, that "the humiliating position of the nation brought about by the present condition of the merchant marine was beyond expression. They had permitted their rivals to seize and hold the pathways of commerce practically to the exclusion of the United States. Of all the enormous exports and imports of the country, American bottoms last year carried only 9 per cent. The United States paid foreign nations, principally Great Britain and Germany, five hundred thousand dollars daily for doing the carrying trade from that country." There is no denying the literal accuracy of this; the difference arises over the remedy. The decline of American shipping dates from the launch of the first iron sailing ship in Europe; and its pace was greatly accelerated when steam began to take the place of sails as a motive power. It is beyond question that down to recent years Americans found it impossible to produce steam vessels of iron and steel at anything like the cost ruling in the United Kingdom. They claim that they are still at a disadvantage in this respect, but on that head we will add something more just now. Here we may say that the proper economic thing to do when it is desirable to maintain your position and you are unable to furnish the means of doing so yourself, is to go to the man who will furnish them. This is what Norway did with profit to her owners and employment for her people. But in America there was a wooden shipbuilding industry, once a proud possession, which had to be kept in a sort of galvanised moribundity; and as the capitalists were busy developing railroads, matters were allowed to drift, and about the time when the Cramps finished with wood on the launch of the "big three," the nation awoke to the fact that nearly the whole of its inward and outward carrying trade was in the hands of foreigners. The coastwise trade it contrived to hold by the simple expedient of excluding the foreigners from it; and as the commerce of the country has grown enormously in the past decade, it is not surprising that the tonnage engaged in coasting has also increased. It is due to this, and this alone, that the total tonnage of American shipping shows expansion. The report of the Commissioner of Navigation tells us that at the end of June last there were 23,333 vessels of 5,164,839 tons flying the American flag. But Mr. Chamberlain is constrained to point out that American vessels are almost wholly confined to the coasting trade, which employed last year 4,338,145 tons, while in the foreign trade there were no more than 816,795 tons. He rubs in the lesson further by this observation:—"The thirty principal steamship companies of the world own 1600 steamships of 5,616,000 gross tons (including some vessels now building), or one-fourth in tonnage and more than one-quarter in carrying power of the world's ocean steamships. Of these, only nine, of 81,000 tons, owned by the International Navigation Company, are American." Senator Frye was quite right in describing the present maritime position of his country as humiliating beyond expression.

As the good American, if he would claim the privileges of American registry, may not go abroad for his ships, it follows that he must have them built at home or else go out of the business. The question now is: Can the American ship be turned out at a cost equal to or not much in excess of that prevailing in Europe? The bounty mongers say it cannot; the common sense of the country is inclined to believe it can, having regard to the cheapening of materials and the other concomitants, in proof of which it points to the activity of the last year or so. Grant that the increase of shipyards is referable in part to anticipations of the passage of a Subsidy Bill; but that will not account for the steel tonnage recently launched or at present under construction. If it were true, as Senator Frye is credited with saying, that it costs 80 per cent. more to run American than it does to run English and Norwegian ships, then it would manifestly pay the States to discourage shipbuilding. But that estimate is absurd—it is the way of the sponsor of the Subsidy Bill to spoil a plausible case by outrageous exaggeration. There is in some respects an initial advantage to England, but this would be neutralised by the profits of carrying if done in American bottoms, added to the prospect of more regular employment for tonnage in good times and bad together. In a paper read a few days ago before the American Society of Naval Architects and Marine Engineers on the possibility of American competition with foreign builders of steamships, Mr. George W. Dickie declared that Americans possess all the necessary skill in design, but that the cost of labour and material are obstacles to successful competition. Some of Mr. Dickie's remarks are worth quoting. "The British ship," he said, "is the result of British experience gained by British shipowners and sailors embodied in British designs by the British naval architect, finally taking form in British shipyards, the result carrying with it much of the traditions and practice of the people and place where the work is done. Now can we in America do better than this? We are likely to do a little different, as much different probably as the limitations referred to will allow, and these differences, I think, will take the form of a closer adaptation of the material used to its place and function in the complete design. In this the steel manufacturer will likely take a share. As he becomes better acquainted with the special needs of ship construction we will find him ready to undertake new sections better adapted to take the strains and stresses of ship structure and reducing built-up work to a minimum. We are, on this point, now abreast of the British builder, and in methods of handling ahead of most of them. In skill, I think the American naval architect is quite abreast of his British cousin, and if he has plenty of practice there need be no fear of his not keeping in that position. In some of the great shipyards of Britain and Europe they have acquired a greater experience in the production of the largest ocean steamships, both for passengers and freight, than we have; but we are in the way of obtaining this experience, and it will come to us just as it came to them—by a steady and skilful application of what we now have." On present methods Mr. Dickie believes American labour costs 25 per cent. more on the hull and 50 per cent. more on the machinery of an average ocean-going freight and passenger steamer; and as near as he can judge there is 10 per cent. in cost of material in favour of the British shipbuilder. One remedy offered is the fixing of a certain value upon each part of a ship, to keep it from exceeding its cost elsewhere. We do not see the difference between that proposition and one to compete with foreign builders. As to paying more for materials, what becomes of all claims recently made on behalf of American methods? They told us that one-fifth of the total iron and steel product for the last fiscal year was sold abroad because the prices undersold those of rivals. Surely the two contentions are irreconcilable? But perhaps the argument applies to finished machinery rather than the unfinished materials that must be worked up into ship frames and plates? A comparison which went the round of the American press not long ago, and which was heralded by much flapping of wings, put the difference in the cost of foundry iron in favour of America at 10s., and of merchant bars £5. As to labour cost, again, did not the Cramps discover some years ago, when they were bidders for a British ship, that their figures on this head were about those of their British competitor, who won because he enjoyed an advantage in the cost of materials? The statement that a day's wages in England are 30 to 50 per cent. less than in the United States, and that, therefore, labour costs more in this country, is defective in logic as well as false in fact. We are driven to the conclusion by the showing of the Americans themselves that we have now no advantage over them in materials, and little enough in labour cost. There remains the cost of maintaining a ship after it has been built, and in this connection we are tempted to ask whether Congress ought to overcome that obstacle by assessing the whole people in order that the shipowners may profit in a business in which they are unwilling to be independent competitors. But it seems to us that the magnitude of this obstacle has been grossly overstated. In his report the Commissioner of Navigation acknowledges the activity in steel shipbuilding at the present time, and he refers it to the coasting law and its recent extensions, heavy expenditures for naval construction, and the building of vessels to replace those bought for transport and the postal subsidy law. Would there have been such a development if the cost of maintenance of American ships were so heavy as it has been claimed to be?

THE YORKSHIRE COAL TRADE.

To those outside the coal trade the applications the Hull and Barnsley, and West Riding Railway Junction Railway Companies are making to Parliament for powers to construct a number of extensions in the South Yorkshire coalfield may seem a bold step. To those interested in the trade the applications require but little explanation, and in justification of the course taken it may be stated that the quantity of coal sent to ports for export up to the close of November reached 3,864,960 tons, or 616,000 tons more than was sent in the corresponding period of last year, and 322,000 tons more than was despatched during the whole of last year. The business coast-wise has during the eleven months increased, being 64,000 tons more than was sent in the whole of last year. The exports during the past eleven months exceeded the business done in the corresponding period of last year by 238,823 tons. The rapid expansion of the trade, which seems never to flag, is held to be a sufficient justification for the applications about to be made. In all probability the increase is without a parallel in the history of any district; for whereas three or four years ago two and a-half million tons was looked upon as a vast tonnage, in all probability four million tons will by the end of December have reached the port in 1900, forming a record year. Some years ago it was considered to be a bold step when the Denaby Colliery Company offered to pay or send a tonnage of 310,000 over the projected line from the collieries to Wrangbrook. In 1898 the firm supplied 494,352 tons, and 440,712, chiefly by rail, to the port, whilst during the past eleven months the firm has forwarded 501,584 tons. This shows the advantage of having directed communication with the Hull and Barnsley Railway. To place other collieries in a similar position the proposed extensions are sought. It may not be generally known that at the present time two extension lines are in process of construction. The new Dearne Valley Railway, which will place Houghton Main and Grimesthorpe collieries in direct communication with the trunk line, is nearing completion, so far as the northern section is concerned, whilst satisfactory progress is being made with the South Yorkshire extension, Hull and Barnsley Railway, from Wath to Wrangbrook, which will tap Manvers Main, Hickleton Main, and the new Frickley estate, which has been leased by the Carlton Main and Grimesthorpe Colliery Company. The resources of the district are very great. The Parkgate and other seams

below the Barnsley bed have recently been reached at several collieries which for years have been working the thick, or Barnsley, seam of coal.

AMERICAN BRIDGE-WORK FOR THE UGANDA RAILWAY.

A Reuter's telegram from New York, dated the 6th inst., stated that the American Bridge Company had contracted for the supply of thirty-four bridges on the Uganda Railway, that the work would require more than 8000 tons of structural steel, and that the value of the order exceeded 1,000,000 dols., say £200,000. We are now in a position to say that this statement is substantially correct, though the amount of steel and the price to be paid are not as quoted. The actual amount of steel work is about 7000 tons, and the price paid about £135,000, or at the rate of just over £19 per ton. On Tuesday last, in the House of Commons, the question was put by Sir A. Hickman to the Secretary for the Colonies whether he was aware that orders involving expenditure of many thousands of pounds for bridges for the Uganda Railway had been given to an American firm, and whether he would take steps to prevent such orders from being given in future without full opportunity being afforded to bridge builders in the United Kingdom to compete on the same conditions as regards tests, modes of manufacture, inspection, and erection at makers' works, as the American makers were subject to? Viscount Cranborne replied: The answer to the first paragraph is "Yes. With regard to the second paragraph, tenders were invited in the United Kingdom on drawings and specifications prepared by Sir A. Rendel, the consulting engineer, under the same conditions as regards tests, &c. One of the American tenders was found to be considerably the lowest in every respect, and was therefore accepted. British firms are always given full opportunity to tender for work for this line, and I need not say that her Majesty's Government are anxious to employ them whenever the terms offered are consistent with the interest of the public service." We may add that we have it on excellent authority that the nearest British offer as regards delivery was to do the work in considerably more than double the time. In reply to further questions by Sir A. Hickman as to whether a principal bridge maker in this country never heard anything about these bridges until the orders were given out, and whether the American bridge maker had to put the bridge together at his own works before sending it away; and by Sir H. Vincent as to whether British makers were invited to tender before Americans, or whether both were invited simultaneously, Lord Cranborne requested that notice might be given of these questions. We are likely, therefore, to hear more of this matter shortly.

THE RAILWAY COAL CONTRACTS.

A good deal of interest is still evinced in the question of the fixing of next year's locomotive coal contracts for railway companies, notwithstanding the statement which has appeared in several papers that the companies had sent another reply to the coalowners declaring that they would accept no tenders unless they were at the rate of 3s. per ton reduction on expiring contracts. The Yorkshire coalowners state that they have heard nothing whatever about the contracts. The coalowners contend, in the face of the two promised reductions to the miners, that the price sent in is fair, and they point out that the Midland Railway Company is now purchasing steam coal in the open market at 15s. per ton. Various opinions are expressed as to the result of the negotiations, but it is admitted as somewhat singular that the various railway companies have not made an offer officially, and although the coalowners are said to be united, there are misgivings as to what course some may take in the present state of the coal trade with a view to keeping their pits at work.

LITERATURE.

Sir A. Cotton: His Life and Work. By Lady Hope. London: Hodder and Stoughton. 1900.

No book of late years has come more opportunely than this. It finds us, on the one hand, at the close of four disastrous years of scarcity and famine in India, and on the other hand at what seems likely to be the commencement of a period of great irrigation work in South Africa. No one could more justly claim to be the apostle of irrigation than Sir Arthur Cotton, nor could anyone have striven more ably or more strenuously for its claims as a remedy for famine. The book before us gives a vivid picture of the life and aims of a man who, as he has described himself, had "one idea," and there is little in it that can claim attention as a technical work; but it is nevertheless one of intense interest to those who are prepared to study the problems of our great Eastern Empire with an impartial mind.

Born in 1803, Cotton entered the East India Company's College at Addiscombe at the early age of fifteen. He passed out with distinction, became an officer of Engineers, went out to India in May, 1821, when he was just eighteen, and was posted to the Madras Presidency. On arrival he was appointed to the "Tank Department," but his first charge of importance was to make a survey of the Paumben channel between India and Ceylon. In those days public works in India received but scant attention, and the provision of funds for new works was on a very modest scale compared with after developments. The work, in fact, could have consisted of but little else than the construction of civil buildings and barracks of a rudimentary type, the laying out of fair-weather tracks, and the maintenance of the old native irrigation works. It was to these latter that Cotton turned his vigorous mind from the first, recognising their importance, or rather the urgent necessity of extending them as a means of improving the condition of the people, while creating at the same time a valuable source of revenue to the State. His first great project was the improvement of the system of irrigation from the Cauvery River, in Tanjore, one of the largest in Southern India. Hitherto the river had only been made use of in the rainy season, when its value was least. Cotton's proposal was to dam the stream at two points above the neck of the delta and to preserve the waters for use in the dry season. The two dams were made in accordance with native methods, the work consisting practically of a heart of sand, or sandy earth, protected on the down-stream with heavy rough masonry, and with a long apron of stone below. The cost of these, including subsequent additions, came to no more than about £104,000, and the result to the State, as officially recorded, was a return on the outlay averaging 133 per cent. in the first fifteen years. It is noted, however, that the stone for one of the dams was derived "from the boundary wall of an ancient temple."

Cotton then took up, in 1837, the question of irrigation from "tanks." These are, in fact, reservoirs, both small and large, some impounding over a square mile or even more, and in Southern India are extraordinarily numerous. They mostly run in chains of tanks down a valley, each tank having its cultivation below the dam, and, below again, another tank is formed. The extent of these small reservoirs may be gathered from a statement that if all their embankments were added together they would suffice to make a wall of earth 6ft. high one and a-half times round the globe. The design of these works is generally very primitive, and the waste weirs are so inadequate and so poorly built that it is common even now for a whole chain of tanks to be destroyed and emptied by the bursting of the uppermost dam in a heavy fall of rain. They are also, of course, liable to be silted up. Over an immense area of the Nizam's dominions in Hyderabad there are at the present day thousands of square miles, much of it of excellent soil, which are now covered with the ruins of such tanks, and with the evidences of a former large and thriving population. It is at present, in most parts, little better than a jungle. Cotton pointed out, rightly enough, that unless we gave systematic attention to such works they must go to ruin, and to his elaborate report on the subject was given effect in subsequent years, and to the immense benefit of the country.

Ten years later, in 1844, Cotton took in hand the greatest project of his life, the one, in fact, by which his name will be known to posterity. This was the irrigation of the Godavery River delta. The dam at the head of delta at Dowlaishweram is 7365ft. in length. Its greatest height is 30ft., and in flood 18ft. of water passes over the crest. It is nevertheless built on a somewhat similar design to that already described at the Cauvery. Its three main canals are each 180ft. wide; it provides irrigation for 3000 square miles; gives communication by means of locks between the sea and the upper reaches; its navigable canals extend to 528 miles, and its distribution channels to over 1600 miles in total length. The cost of the works up to the present time has not materially exceeded £1,250,000, while, in comparison, the cost of the barrage alone, built across the Nile by the French engineers, which was useless until we took its reconstruction in hand, cost £1,800,000. Cotton's great point was to do his work with every possible economy, consistent with sound construction; and if we bear in mind that this great work was carried out successfully at a time when there was the utmost difficulty in obtaining skilled labour, or any such appliances as are now common in the country, it must be regarded as one of the most remarkable feats of the many that have been carried out by our engineers in India. More than that, it proved a great financial success. It was on these works that Cotton had the pluck to adopt what is known as the "shallow well" system for foundations—a system copied from native works, but one which could only be justified in shallow rivers with low velocity. To build walls on foundations of small brick wells, sunk no more than 6ft. or 8ft. in sand of unknown depth, would seem to most engineers, as it did indeed to the canal men in Northern India, to be courting disaster. But Cotton knew what he was about as regards his own locality, and stoutly supported his action in the frequent controversies on the subject. The Madras Railway engineers, who copied his method too rashly in the foundations of their larger bridges, have had reason to regret their temerity.

Sir Arthur Cotton left India in 1860, and was knighted. His health was much broken, and his spirit worn by the earnest and constant struggles he had undergone in the promotion of his one idea of canals and irrigation as the only panacea for Indian poverty. In his retirement, and almost up to the last, he lost no opportunity of pressing this on all and sundry. Railways were to him almost a wickedness, and only to be considered when India had been covered to the full with irrigation and navigable canals. He could "think in millions" for water, but would listen to no arguments for expenditure on railways. He made the Select Committee on Indian Public Works, in 1878, a battlefield for the assertion and maintenance of these views; and there can be little doubt in the minds of sound engineers that he had allowed the one idea to paralyse his judgment as to what the real possibilities were for navigable canals in India, or elsewhere, and to blind him to the now recognised and universal demand for speed in transit, whether for goods or passengers. Moreover, in his later years, he led himself too often to idealise, and on insufficient data. His evidence before the Committee as to the negative effects of railways is almost pathetic in their denunciation:—

They do *not* provide food for man or beast.
They do *not* carry the great traffic of the country.
They do *not* carry cheaply enough to answer their main purpose.
They do *not* touch the local traffic either of goods or passengers perceptibly.
They do *not* pay the interest on their capital.
They do *not* drain the country.
They do *not* provide wholesome drinking water.
They do *not* prevent fever.
They do *not* create traffic.

Quite one half of the book is devoted to the advocacy of Sir Arthur Cotton's views in this respect, and the authors would, we think, have done better, at least, in the interest of most readers, to have given less prominence to what are really polemics of the past. The question must be approached at the present day in the light of modern conditions and present needs; but no better and recent instance could be offered of the futility of making irrigation canals, before providing adequate means of transit for produce, than the case of the canal made lately from the Chenab River into the Rechna Doab. Here we have an important canal scheme which was pressed forward by the Irrigation Department, the work carried out in hot haste, and the ground occupied, as fast as the water could be supplied, by swarms of eager and substantial cultivators. But although the immediate results were excellent, so far as produce was concerned, the villagers found that they had no means of getting this to market; they could not, in fact, sell their crops. In hot haste again, the irrigation officers had to press the Government to give them a railway, and with some difficulty the money for this has been found and the position is at last satisfactory. The book is written, as we have indicated, with the avowed intention of advocating Sir A. Cotton's views, and this has been thoroughly done, almost indeed overdone; but while readily acknowledging Cotton's talent, versatility and perseverance, the verdict of most readers will be that while he was a safe man at work, he was a too kindly, and even rash enthusiast as a projecter. The book teems with ample evidence of this, while the record of his later years seems to indicate that his life was passed in too narrow a circle, and that he was thus unable to get into touch with modern ideas and needs. But, nevertheless, it was a grand and useful life, and we cannot but thank the authors for its story.

We have not space to give adequate notice to the chapters on famine questions—which are apparently written by Mr. W. Digby—nor, indeed, would they be of interest to many of our readers. It is enough to say that their *motif* is the value of irrigation as a means of prevention of famine. This need not be denied, but the desirable and the possible are two different things, and when we have the testimony of Lord Curzon, supported by the best expert advice, that the possible area now left in India for irrigation is under 4,000,000 acres, it is surely a mistake to labour the point too much. On the other hand, we are quite prepared to believe that the beneficial effects of railways in preventing famine in India have been overestimated, and it is quite possible that by their stimulus to the export of food grains they have served to create a position in time of scarcity which might be well worthy of investigation.

SHORT NOTICES.

The Practical Engineer Electrical Pocket-book for 1901. Manchester: Technical Publishing Company, Limited. London: John Heywood. Price 1s. net and 1s. 6d. net.—This is the second issue of this small book, and it has been enlarged by added matter from 256 to 292 pages. The result has been that the references to the same things do not come in the new volume on the same pages as the old. This in a second number is possibly unavoidable, but is nevertheless a disadvantage for persons having got accustomed to the numbers of the pages in one book, do not care to have, in the next issue, to look out in the index where they come. This is, in a way, a minor point. The new issue is an improvement over the first. Much has been re-written, and there are numerous extra tables, not the least interesting of which is a table for proportioning the dimensions of resistance frames.

Fowler's Mechanical Engineer's Pocket-book, 1901. Manchester: Scientific Publishing Company.—This useful little volume appears to be very fairly up to date, and its information is generally taken from trustworthy authorities. We might, perhaps, point out that the tests of the Diesel engine quoted from The Engineer were conducted by Professor Schröter, not Schorter. The very interesting oil engine invented by Professor Báuki, and described in our issue of November 30th, might have been mentioned. The section on springs—considering the importance of the subject—would bear longer treatment. In the electrical section, we note that the Diatto system, working successfully at Tours, is not mentioned, whilst several others now out of date receive attention. We mention these minor points as possibly of value to the editor in preparing future issues; they do not seriously impair the present edition.

Hazell's Annual for 1901: *A Cyclopædia Record of Men and Topics of the Day.* Revised to November 30th, 1900. Edited by W. Palmer, B.A. (Lond.). London: Hazell, Watson, and Viney, Limited. 1901. Price 3s. 6d.—This is a volume which owes its success almost entirely to the topical character of its contents. It will, we think, be found as valuable to-day as when its first issue appeared many years ago.

BOOKS RECEIVED.

The Railway Diary and Officials' Directory, 1901. London: McCorquodale and Co., Limited. Price 1s.

Railway Runs in Three Continents. By J. T. Burton-Alexander. London: Elliot Stock. 1900. Price 7s. 6d. net.

Lawyers and their Clients: A Practical Guide for the Latter. London: Effingham Wilson. 1901. Price 2s.

A Practical Treatise for the Use of Boilermakers, Iron Shipbuilders, and Mastmakers. By I. J. and H. Haddon, boilermakers. Published by the Authors, 83, Splott-road, Cardiff.

A Treatise on Elementary Dynamics: Dealing with Relative Motion mainly in Two Dimensions. By H. A. Roberts, M.A. London: Macmillan and Co., Limited. 1900. Price 4s. 6d.

The Principles of Mechanics: An Elementary Exposition for Students of Physics. By Frederick Slate. Part I. London: Macmillan and Co., Limited. 1900. Price 7s. 6d. net.

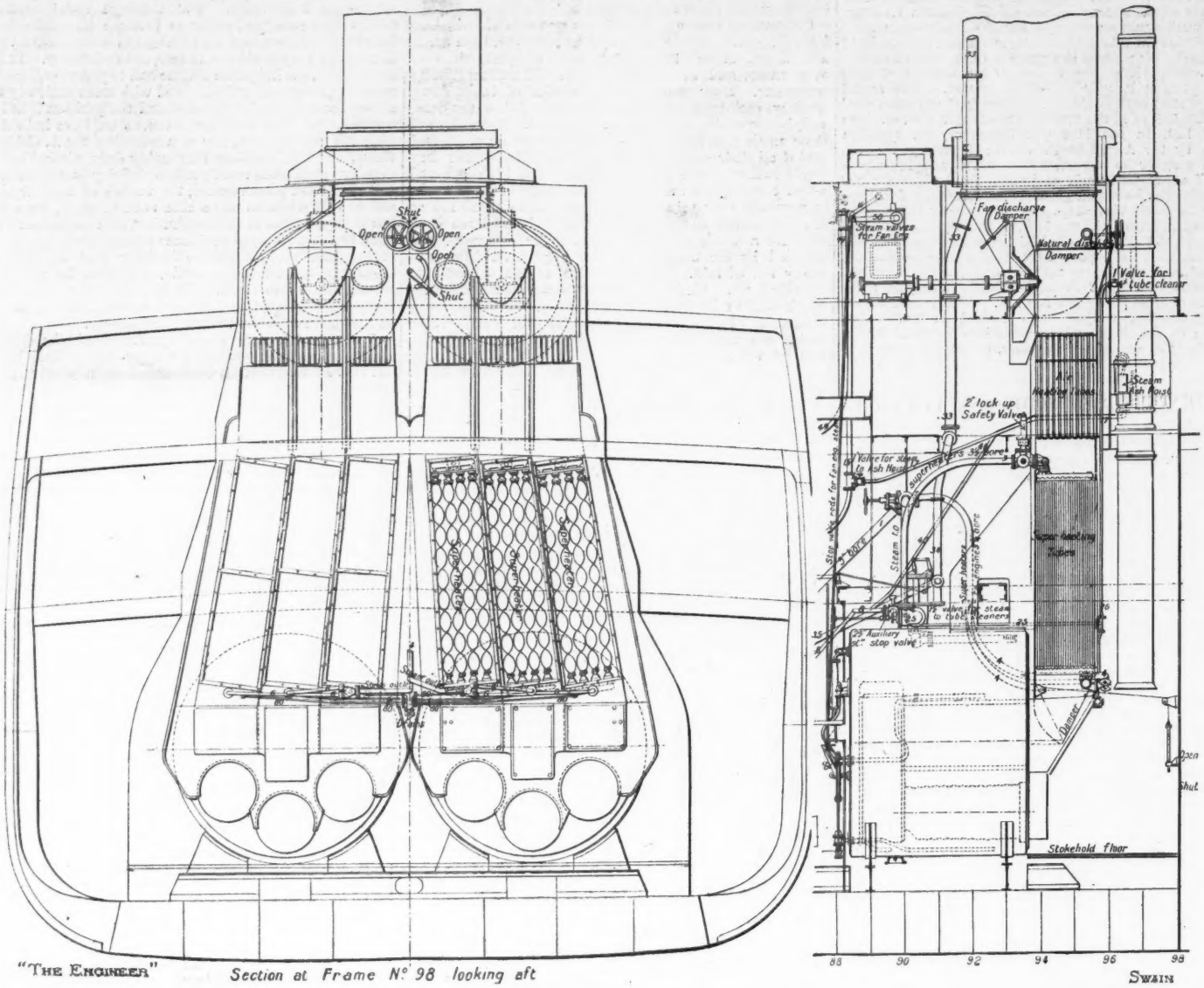
Traité Théorique et Pratique du Rivetage des Charpentes Metalliques des Navires et des Chaudières suivi d'un Manuel Détaillé, pour le Rivetage des Navires. Par G. Maugas. Paris: Augustin Challamel, Rue Jacob, 17. 1900. Price 6f.

Excerpt Minutes of Proceedings of the Institution of Civil Engineers. Vol. cxlii. Session 1899-1900. Part IV. Bell on "The Manufacture and Use of Rails in Great Britain," and Andrews on "The Wear of Steel Rails in Tunnels." Bidder and Fox on "The Great Central Railway Extension." Blake-Walker on "By-product Coke Ovens." Brightmore on "The Setting-out of Two Tunnels on the Elan Aqueduct." Cullen on "The Removal of the Lytton Rocks." Deane on "Economical Railway Construction in New South Wales," and Stirling on "The Tocopilla Railway." De Burgh on "The Use of Monier Pipes as a Pile Covering." Fergusson on "New Method of Dividing Surveying Circles." Gordon on "Irrigation in Victoria." Hunter on "The Naval Section of the Nicolaieff Dockyard." Jackson on "The Design and Construction of Steel Bridge Work." Money on "The Palermo-Corleone Railway." Nardin on "The Chlorination of Gold Ores at Mount Morgan, Queensland." Preece on "The Relations between Electricity and Engineering." Vernon-Harcourt on "The Deposit of River Silt." Abstracts of Papers in Scientific Transactions and Periodicals. Edited by J. H. T. Tudsbery, D.Sc., Secretary. London: Published by the Institution. Westminster, 1900.

SUPERHEATERS—S.S. INCHDOWNE AND INCHMARLO

THE CENTRAL MARINE ENGINE WORKS, WEST HARTLEPOOL, ENGINEERS

(*For description see page 597*)



LABOUR TROUBLES.

THE mineral guards employed on the North-Eastern Railway and the Sunderland and Tyne Dock struck work on Monday to the number of 130. The cause is stated to be owing to the introduction of a new regulation with regard to the working of guards' vans. The men demand that they shall be allowed to work their own vans as heretofore. Very few mineral trains as a result left Sunderland on Monday, and should the dispute be not quickly settled the coal trade of the district and the dock will be seriously affected.

The Conciliation Board in connection with the railways, especially of the South Wales district, the Taff Vale, Barry, Rhymney, and Cardiff Railway, was brought prominently forward on Monday before a meeting of the Executive of the Amalgamated Society Railway Servants, London. In making his report to the Committee, Mr. R. Bell, M.P., referred to the question of the proposed formation of a Conciliation Board for South Wales. He expressed regret that such a board was not yet formed. The men had done all they could, but the companies had not done much. Mr. Bell touched upon the steps taken from October 21st, and the delay which had followed. He also referred to the Taff Vale Railway, and stated that a good deal of feeling existed amongst the men, caused by the retention of the imported men. With respect to signalman Ewington, Mr. Bell reviewed at length the course taken in getting him replaced, and these, he thought, would eventually result in the appointment of Ewington to the place he sought. After some desultory conversation the Executive refrained from passing any resolution, but agreed to await developments.

The great strike at the Penrhyn Quarries, North Wales, has almost depopulated the once thriving village of Bethesda. Some account of the industry and the place may be of general interest. Bethesda is altogether dependent upon the quarries, and has only just recovered from the strike four years ago, when, on account of a dispute with some of the officials, work was suspended for twelve months. The men employed number 3000 at the quarries, and 200 at the port. The annual output is 120,000 tons, and to get this one million tons rubbish are displaced. The wages total nearly £35,000 fortnightly. In the blasting 5090 lb. of black powder, 1600 lb. gun-cotton and gelatine, and 600 yards of fuse, are used monthly.

The great majority of the men are now scattered over a wide area, many of them being employed at the Glamorganshire and Monmouthshire colleries. The men state that their principal grievance is the action of the management with regard to a number of men who were prominent in the strike of 1896. These, it is alleged, have had to suffer from the part they took, and the inference with the men is, that a similar course will be followed with the principal leaders should work be resumed. A pacific step has been taken by the management within the last few days, in refraining from the prosecution of quarrymen charged with assault. On the side of the men the deadlock continues. On Saturday there was a widespread belief in the district that the men were coming back, but it appears that this was caused by the return of a number of them to spend Sunday at their homes. On Monday these again departed. One thousand seven hundred men have now left, and are engaged elsewhere.

Under the belief that the wages rate is threatened, an important meeting of engine drivers, firemen, smiths, &c., was held on Saturday evening at Melincrythan, Neath. Addressing the meeting, the General Secretary of the Welsh Artisans' Union stated that an important section of workmen, engaged in producing steel bars, would at the end of this month have 10 per cent. less wages. So adverse was the effect of the importation of American tin-plate bars upon Welsh steel workers that already much distress prevailed amongst them. To secure employment, some were granting concessions in weight, and others were offering to work on double the reduction now coming into force. In June the wage contract of the tin-platers, which secured to them the 1874 list, would expire, and unless something very unexpected took place, employers would seek wage reductions. An effort might be made to interfere with the artisans at tin-plate works. They, however, occupied a very different position from that of the men actually engaged in tin-plate manufacture. The artisans were paid by the day, and their wages were based on the recognised wage rate paid to men of their class outside tin-plate works. The artisans held a position of exceptional strength if they were combined in defence of their mutual interests.

One of the first of the allied industries to feel the drop in steel prices is the coke works. On Friday notice was given at the Cambrian Coke Works, Briton Ferry, to terminate contracts in fourteen days, after which time contracts will be made from day to day.

No industry in Wales has benefited by the inflation of coal prices more than building, and though one or two building societies have not succeeded, the majority are thriving, and the wages of masons, carpenters, &c., are proportionately high. Masons are reported as getting ninepence per hour, and carpenters and others are paid in proportion.

At the East Glamorgan Miners' Association, held at Caerphilly on Monday, Messrs. Jenkins and Nules reported a satisfactory ending of the dispute with the winding enginemen at Price's Colliery, Rudry; but the tippers' and siders' wages dispute was left in abeyance for further investigation by the management. A satisfactory new departure was made by the association at the close of the meeting by the resolution to grant a donation of 30s. each to all the old and infirm colliers of the district.

The feeling is growing strongly throughout all districts trending upon coalfields that the high rate of wages which has crept up in sympathy with the wages of miners demand a revision. With regard to South Wales and Monmouthshire, the successive advances upon the standard of 1879 affect all grades and conditions. The collier, who was able to earn from 25s. to 30s. a week, is now able to get £3, and in many instances, when aided by a boy, £4 to £5. The result of this has been an influx of all kinds of artisans, and although the colliers themselves aid in preventing unskilled men going into the headings, a good deal of work, especially on the surface, is done by the new men. There are now in the Taff Valley Collieries bakers, painters, tailors, tinkers, and others actively employed, who are easily able to earn at least double the amount they obtained when following their old occupations. It is tolerably certain that the wages of Welsh colliers will remain for a time, and even a slight advance may be looked for at the next audit. Almost as certainly a drop is impending in steel and tin-plate wages, and expectation is strong in the district that a revision of wages generally is at hand. The coalowners' and colliers' representatives in committee have agreed to investigate at once the great inroad of unskilled workmen into the mines, and the weeding out of these may be regarded as the beginning of other labour troubles.

The latest intelligence concerning the strike of the mineral guards on the northern section of the North-Eastern Railway is that the efforts at conciliation on the part of Mr. Bell, secretary of the Amalgamated Society of Railway Servants, have failed.

A notice has been posted at the Albion Steel Works, Briton Ferry, to the effect that contracts from date will be from day to day.

A colliers' strike has taken place in the western district. The workmen of two collieries are affected, Craig Avon, Aberavon, and Glanmorwg, Llangennech. The men, who number about 150, demand a revision of the wage rate. They are at present in receipt of strike pay from the Western Miners' Association.

EASTON AND COMPANY, LIMITED.—We understand that a syndicate under this title has been formed to take over the works and connection of Easton, Anderson, and Goolden, Limited, of Erith. The syndicate has been formed to introduce the Schmidt superheated steam engine. Full particulars of the purchase of patents are given in the prospectus. We have already noticed the Schmidt engine favourably in our pages. It is stated that over 87,000 horse-power are now in use, representing 370 engines. The share capital of the syndicate is £100,025.

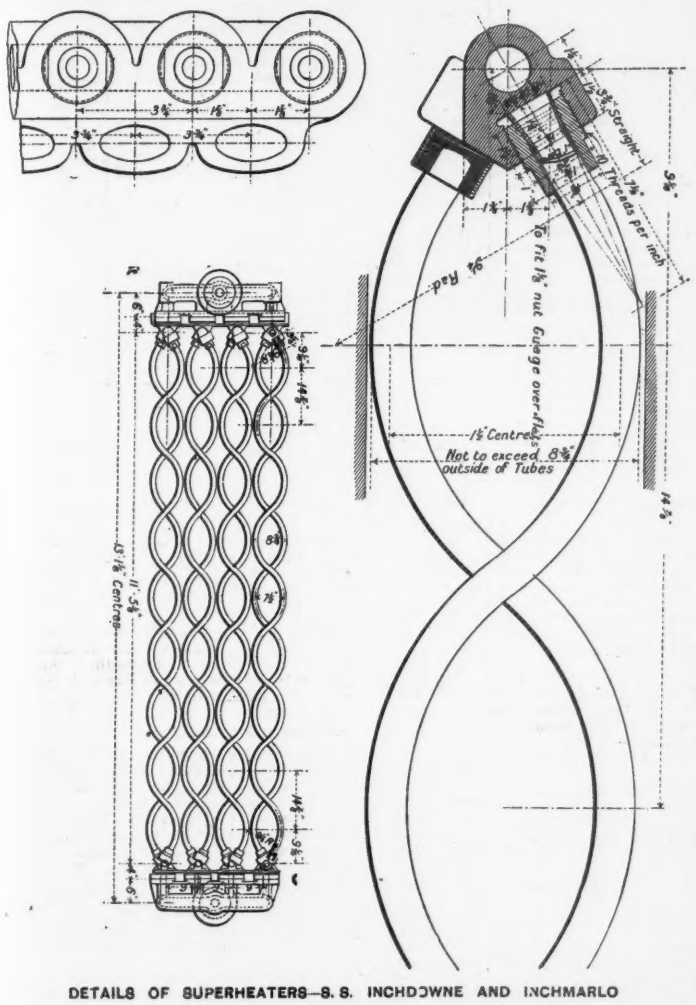
BOILER EXPLOSION, SUTTON HEATH POTTERY

SUPERHEATERS, S.S. INCHDOWNE AND INCHMARLO.

WE have already referred in our issue of November 16th, to the remarkably high economical efficiency of the steamers of the Inchmona group, fitted with five-cylinder engines, constructed under the patent of the late Mr. Thomas Mudd, by the Central Marine Engine Works, West Hartlepool. The latest additions to this group of steamers are the Inchdowne and the Inchmarlo, which have probably attained the highest economy of fuel yet reached by the marine engine in practice.

We illustrate on page 596 the superheater and the general arrangement of the boilers. The furnaces are worked with forced draught and hot air, on the Ellis and Eaves' system. Two fans are placed on the upper deck and drive the air through a heater as shown in the longitudinal section of the ship, between frames 88 and 98. The superheaters consist of twisted tubes placed in the uptakes, and occupy a height of about 14ft. by a width of 10ft. for each boiler. The superheaters are six in number, three for each boiler. The boilers are 13ft. in diameter by 10ft. long, and each has three furnaces 3ft. 6in. in diameter.

The total height between centres of each superheater is 13ft. 1⅛in., and it is composed of eleven tiers of tubes, 1⅝in. diameter. The length occupied, measured parallel to the keel, is 3ft. 6in. The details of the attachments are clearly shown in the enlarged drawings. The results obtained so far are all that can be desired. We shall have more to say about the ships in a succeeding impression.



DETAILS OF SUPERHEATERS—S.S. INCHDOWNE AND INCHMARLO

A REMARKABLE BOILER EXPLOSION.

ON Thursday morning, the 29th of November, a somewhat remarkable explosion occurred at the Sutton Heath Pottery, near St. Helens, of Mr. R. Holmes Twist. The pottery is situated behind a row of cottages, and there are employed about twenty-five hands. In the engine-house there were two Cornish boilers 15ft. long, and each weighing about three tons. The workpeople were about to start washing clay for the pottery, and to enable them to do so the engineman left the boilers and went to start the machinery. While he was in the act of doing this, one of the boilers exploded, and the force of the explosion lifted it clean out of its bed and sent it flying through the roof, to a height of 30ft. over the cottages, and on to the adjoining road, the boiler, now so much scrap iron, ultimately resting about a yard and a-half in front of a small one-storeyed cottage. The engine-house was utterly wrecked, the other boiler was tumbled from its position, the works chimney was damaged, and the roofs of the adjoining cottages were smashed, while the windows of all the houses in the neighbourhood were broken by the force of the explosion. Bricks were hurled to a great distance, some being found some 200 yards away, while large holes were made in some of the buildings by the falling *débris*. In the midst of all this damage the most remarkable thing is that no one was badly injured. Indeed, the only serious case is that of a young woman who was opening a door at the time of the explosion, and was struck by a flying piece of slate near the eye, inflicting a cut. It is not often that an entire shell is thus ripped clean away from the ends.

NEW SOUTH WALES RAILWAYS.

As these railways are looked upon as the leading and most progressive throughout Australia, the annual report of their working is anticipated with interest. The results for the year ending 30th June last are just published. Taking the rate of interest at 3·639 per cent., the average interest paid on the debt of the Colony, the result of the year's working, after providing for all working expenses and interest, shows a marginal deficiency of £6135.

In the working expenses are included heavy items for extensive renewals, &c., of which the following items may be specially mentioned:—Substitution of steel for iron rails over a large section of the Northern line; renewal of the timber viaduct over the Murrumbidgee at Wagga, by a steel structure; more extensive repairs and renewals of rolling stock; increased cost of coal and materials generally; granting of increased wages to the staff. These items increased the working expenses of the year by £79,078.

The revenue shows a net increase of only £18,299, but while the passenger traffic shows a satisfactory increase of £57,025, and general merchandise, grain, coal, and other minerals, an increase of £85,013, the following items of traffic show considerable decreases, viz.—Live stock by £63,091, wool by £55,234, and hay, straw, and chaff by £17,546. In connection with the live stock traffic, rebates, amounting to £40,000, have been allowed off the ordinary rates in the carriage of starving stock, and on fodder in cases where the removal of stock was not considered practicable. These concessions were given as a means of saving the lives of an immense quantity of stock during the drought, which, but for the assistance afforded, would probably have perished. Reductions have also been made in rates and fares which have affected the past year's revenue to the extent of about £15,000.

The following lines were opened for traffic during the year:—

	m.	ch.
Broken-hill to Tarrawingee	40	7
Tamworth to Manilla	29	42
Moree to Gravesend	85	0

The Broken-hill to Tarrawingee line is one that was formerly in the hands of a private company, but now having been bought by the Government of New South Wales, has been leased to the Silverton Tramway Company for a period of five years, which, in addition to keeping the line in order, pays 3 per cent. on the capital outlay.

Satisfactory progress has been made in the rolling stock for the accommodation of traffic, and in the condition of the lines. Pullman sleeping cars have been placed on the Western mail trains, and bogie carriages have been fitted with corridors and lavatory accommodation for the branch lines. During the year six powerful goods engines have replaced nine old ones of smaller type. Eight passenger tender engines and three goods tender engines were rebuilt, and the carriage and wagon stock has been strengthened by the rebuilding of 98 vehicles, and the construction of 251 vehicles of larger carrying capacity to replace others worn out, the cost of all the above being charged to working expenses.

A large air compressor, of the Ingersoll-Sergeant duplex compound type, has been added to the plant at the Eveleigh workshops, for actuating portable tools. All the machinery, shafting, and overhead cranes in these shops are now being driven by electricity, generated at the electric power house Ultimo.

A number of special machines of recent designs have been ordered, so as to place the workshops on the most modern basis.

Attention is again drawn to the necessity of extending the railway into the city. The number of passengers conveyed to and from Redfern Station increased from 9,904,864 in 1890 to 13,511,096 during the past year.

Branch lines.—Of the total miles open for traffic, eighteen branch lines, totalling 1286¾ miles, are shown as unprofitable. The aggregate returns on these lines are as follows:—Capital cost, £14,140,666; total earnings, £599,973; working expenses, £405,804; interest on capital, £512,209; net earnings, after paying working expenses, £194,169; loss, after paying working expenses and interest, £318,040.

One of the best methods of gauging the goods traffic carried is shown in the ton-mileage statement, of which a copy is given as under:—

Description of traffic.	Tons carried.	Ton miles.	Average miles per ton.	Earnings exclusive of terminal charges.	Earnings per ton per mile.
			Miles.	£	d.
Coal, coke, and shale ..	3,406,769	54,278,267	15·93	136,650	·60
Firewood	204,820	5,928,689	28·95	19,481	·79
Grain, flour, &c.	361,052	61,359,264	169·95	142,945	·56
Hay, straw, and chaff ..	118,631	20,925,585	176·39	29,714	·34
Miscellaneous	525,503	36,821,437	70·07	102,265	·67
Wool	84,678	20,941,076	247·30	206,594	2·33
Live stock	188,595	45,994,741	243·88	295,798	1·54
A and B classes	354,008	34,066,102	95·99	189,887	1·33
All other goods	286,555	40,054,691	139·78	558,171	3·34
Total	5,531,511	320,364,852	57·92	1,678,005	1·26

New South Wales tramways.—Special interest is attached to the tramway report in consequence of the partial conversion of the lines to electric traction and the inauguration of the system of penny fare sections. On June 30th last, 71¼ miles of line were open for traffic. The north shore cable line was converted into electric from February 11th last, and the Dulwich-hill to St. Peters steam line into electric on April 2nd. Forty-three electric cars have replaced a similar number of steam cars, the cost of which has been a charge to working expenses; 133 new electric cars have been added to stock. Large orders are in hand for the further supply of electric tram cars. The introduction of penny sections simultaneously with the opening of the electric line in George-street induced a traffic that largely exceeded expectations. On the section between Circular quay and the railway station alone an average of about 70,000 persons are carried each week day. Since the opening of the George-street line on December 8th, and the conversion of the Dulwich-hill and St. Peters line on April 2nd last, the number of passengers carried over these sections alone amounted to 13,246,533. The work of converting the remainder of the steam trams to electric traction is receiving every attention, but it is stated it will not be possible to do much more in this direction until additional machinery now under order has arrived from America.

LETTERS TO THE EDITOR.

(We do not hold ourselves responsible for the opinions of our correspondents.)

NAVAL ENGINEERS.

SIR,—To use an American expressive phrase which, as the manner of expressive phrases often is, is just a little vulgar, your correspondents "Naval Encumbrance" and "Dum Spiro Spero" make me tired. The latter gentleman is easily done with. His letter is simply a plaintive wail that his state-room is not on the upper deck. He has my sympathies. I know what it is to have to try to sleep or write or read down below near the engines. Yet I do not see how he can improve his position save by leaving the Navy. I am sure a life on board ship is not good for him, and the sooner he seeks more comfortable quarters on shore the better it will be for those he leaves behind.

The letter of "Naval Encumbrance" deserves more notice. At first I thought it must be a joke—a thing "writ sarcastic;" but on reading it over the third time I began to see that it has been written in sober, ignorant earnest. And what a picture it presents! What light it throws on dark places. How clear it becomes that there are men in the Navy who have missed their vocation. Your correspondent draws a lamentable picture of what a chief engineer in the Royal Navy has to undergo. In the first place, he is up all night getting ready for sea—no sleep for him; anxieties pressing him; elaborate calculations to be made before he can tell how many boilers to light up. A mistake in a boiler or two means so much waste of fuel or economy. Then when he has got his engines started and the ship has run a little way out into the Channel, and he begins to think of rest and dinner, that atrocious officer the admiral insists on, not one, but two whole hours being spent at general quarters, doing the gridiron, column in line, and so on. And, after all, is the engineer to have a hot dinner? Far from it, poor fellow; cold beef and pickles are his lot. No wonder it is hard to get engineers to enter the Navy.

Surely, Sir, this gentleman does not know what hard work is. I only wish I had him as my second for a couple of voyages, and I would show him what engineering at sea means. What would become of him if he had to stand, as I have done, a whole night through at the throttle valve, while the screw was half its time out of the water and thrashing enough to tear the stern out of her? Has he ever been battened down for three days and three nights in an Atlantic gale, living on a few biscuits, and glad to get an hour's rest on a sack of waste? What does he suppose happens when a big steamer comes into harbour to load and has to be out again in two or three tides? Has he kept engines running at full power for thirty days and nights on end without a stop? Has he been put into a still hot combustion chamber, with a rope round his middle to pull him out if he faints, to plug the back end of a leaking tube? Has he been down in the bilges in the Red Sea trying to clear choked strums under the engines? How much actual rest does he suppose the chief engineer of a big Atlantic racer gets while she is tearing across the Atlantic to make a record? Does he know that some of these liners have as many as 120 steam cylinders at work most of the time? No wonder I am tired when I read the childish little grumbling of your correspondent at not knowing how many boilers to light up. When I read such letters I begin to understand many things. I begin to see how it is that stand-by boilers are pumped up till the water comes out of the safety valves, because no one on board is able to make the check valves tight. I begin to understand why they do not know how to keep a condenser tight in her Majesty's Navy. I begin to see why it is that no complaints are heard about some ships and others are always in trouble.

Perhaps I have said enough; possibly if I say more your correspondent will retire, and not supply that information of which I am in search. Will he tell me what he is doing during the weeks his ship is lying idle in harbour? I have relatives, not engineers, in her Majesty's Navy, and I know a good deal about the movements of various ships. I have two in my mind at present; they are on foreign stations. The captain of one lives on shore a great deal; small blame to him—the station is hot. Will your correspondent, for the benefit of your readers, kindly tell us what amount of work the engineers of that ship have to do every day? I know, but your readers do not, and it is much better that the information should come at first hand from an engineer who is—as your correspondent obviously is—competent to speak with authority.

This much I may say. The engineers of the mercantile marine do more work and undergo more privations and hardships in a month than the engineers of her Majesty's Navy do in a year. Their life is a very easy one in time of peace. For a few weeks in each year the conditions assimilate more or less closely to those obtaining in the mercantile marine. During the manœuvres the conditions in the engine-room of a cruiser, flying, pursuing, or bearing despatches, are much the same as that normal to an Atlantic liner, but these seldom last more than twenty-four hours.

The engineers in the Navy are, as far as my somewhat extensive experience goes, well-educated gentlemen. Some of the chiefs, in particular, are first-rate men. But take them all round, they are not the right men for the engine-room. On this point I cannot quote better authority than themselves. I never yet met with one of them who was contented with his pay or his position. I never came across a naval engineer yet who did not hold that he was fit for a far higher position than that he held. Dozens, I might say hundreds, of young men try the engineer branch of the Navy, and give it up. It is only with the greatest difficulty that the supply of engineers can be kept up at all. No better proof could be supplied that the wrong men are in our naval engine-rooms than the two letters you have published. It would be most unfair to their fellows to suppose that they represent the best that can be had. I ask for some information as to the life of an engineer, and I am referred to an amusing, interesting, and instructive little story of certain manœuvres. As these things last about a fortnight, they represent a very small section of an engineer's life. Will none of your readers tell us what is the work of an engineer during a three years' commission?

FIDLEY HOUSE.

December 3rd.

SIR,—I note in your issue of the 30th ult., in your leader on this subject, a suggestion was thrown out to the effect that the breakdowns that have occurred in some of our recent warships were due to the incompetence of those who are in charge of their machinery. This has also been more openly declared by at least one of your correspondents, and is a most serious accusation, and one which needs to be sifted to the bottom and cleared up. At the outset the question may well be asked, "If the senior naval engineers, with their great and varied experience of the working of many different types of machinery, as found in our men-of-war, are not competent to take charge of the machinery in our ships, who within the borders of this British Empire can be found to suitably fill their places?" If the hypothesis be true, and more competent substitutes can be found, then it goes without saying that, for the safety of the Empire, the sooner the change takes place, and the naval engineers are bundled over the side, the better. But I write as a naval engineer; I humbly predict that no more suitable or competent substitutes can be found, as a class, of course, and I challenge any of your correspondents to direct us to a possible source of supply of such desirables. Naval engineers are too scarce and mercantile marine engineers none too plentiful for any practicable interchange to be feasible. Breakdowns there are bound to be occasionally, but these, in the Navy, are really very few, and the cases where they are due to mismanagement are certainly not more than one per cent., and in these cases punishment is swiftly meted out to the offenders. There has been a great deal of talk about these breakdowns, and those who are so fond of airing their opinions upon them seem to have overlooked the fact that very radical changes have taken place in the engine-room appliances of our ships of war during the last few years. I refer to the introduction of the Belleville and other types of water-tube boilers. These boilers have shown by their vagaries that they require considerable experience in managing, not only by those in charge but by the whole engine-room staff, for one man cannot be everywhere everywhen. But this experience cannot be procured ready-made, and must be acquired gradually, as it is being done at present, by the engine-room staffs of the Royal Navy. Now, Sir, who is there available, outside of H.M. Navy, who possesses this experience? Do we find it in the mercantile marine, where water-tube boilers are practically non-existent? Or can we discover it in the engineering workshops of Great Britain? The contentions appear ridiculous. Is is possible that want of experience and lack of confidence may have something to do with recent breakdowns? I do not state this as a fact; but if it is so, the concession of greater authority to the naval engineer, and less interference with his men from outside his department, would go a long way to overcome these defects. But the two prime causes of recent breakdowns are due, firstly, to the too wholesale adoption of the water-tube boiler in the Navy whilst it was only in the experimental stage; secondly, to the reprehensible practice, allowed and encouraged by the Admiralty, in doubling the engine-room complements of ships during their contractors' trials, just to get the ship through, and then expecting the same results to be achieved on service with half the number of men. It is expecting too much out of too little, and it is somewhat severe to lay the resultant failure at the door of the naval engineer, who is in no way responsible. It has also been suggested that these failures are due to the fact that a naval engineer is not and cannot be a good practical workman. This is quite immaterial, if true, which I do not admit. But is the difficulty going to be overcome by placing, say, an engine-room artificer in charge of the machinery simply because he is a good fitter or boiler maker or coppersmith? How absurd! A naval engineer may not be able, through want of practice, to perform a job as rapidly as any particular mechanic, but for all that he knows exactly how it should be done—and this in all engineering trades. As for doing it himself, he is not likely to be required to, unless several of his mechanics were *hors de combat*, when he would, of course, with his assistants, willingly buckle to, as mentioned last week in my letter. Commissioned officers are a necessity in a man-of-war, but a man cannot be a workman and an officer at one and the same time, or his authority would be of a very meagre description.

To compare the running of ships fitted with Belleville boilers with those of the Messageries Maritimes steamers, not so long ago, you, Sir, explained to us that one cause for the more satisfactory working of the latter was the substitution of at least three new boilers at the end of each trip. I am told that the steam pressure in those liners is only 180 lb., against 300 lb. in the Navy. This is, if so, a far greater inducement to the breakdowns which have occurred, and which have been for the most part due to leaky joints and consequent shortage of water, also to the necessarily much higher number of revolutions at which Navy engines have to run, and which has caused, in some cases, trouble with the bearings. I have only attempted to outline some of the causes of recent failures, in the hope that those who are ever ready to cast blame may pause and think before impugning the reputation of a large body of hardworking and overworked, conscientious public servants. Breakdowns previous to the transition the Navy has recently undergone were so rare as to be insignificant.

Before concluding, will you kindly allow me to remark that comparisons between naval and mercantile marine engineers are in bad taste, and can in no way affect the main question, which is the status of naval engineers, and the necessity of recognising their importance. If this last is to be decried by the engineers of the country, who can best appreciate the situation—though none but those who live the life can fully do this—the Admiralty are not likely to redress a crying evil. It does not signify who is put to do the work of the naval engineer, the issue will always revert to the *status quo ante*, viz., that those who have worked themselves up into the position of responsibility that rests upon the shoulders of the chief engineer R.N. cannot but realise that they are the mainsprings and most important factors of the modern battleships, and their position is not set at its proper value, and that their authority is too restricted. A few years ago an Atlantic liner was chartered for the naval manœuvres, and put in commission by a crew of naval officers and seamen; the engine-room staff were not changed. At the conclusion of the manœuvres the chief engineer of the mercantile marine said he would not go through it again for £1000 a year, and he had only to drive his main engines.

I think satisfaction could be easily given, by conceding executive rank to naval engineers, without making too radical a change. This is not simply a question of £ s. d., and never will be. With the removal of disaffection, increased zeal, a plentiful supply of candidates, and a greater degree of efficiency would obtain.

December 8th. CHIEF ENGINEER R.N.

P.S.—Since writing the above I have read the remarks of "Weary One," and have no hesitation in dubbing him as one of the "incompetents" of the naval engineers. The engineer meets with daily everywhere at the home ports is "Give us more men to do the bare work necessary to keep things in good order," and if "Weary One's" experiences are different to this, and he is in charge of machinery, we may certainly look for a breakdown in his ship. Even if he had a superabundance of men at his disposal, which we all know has never occurred, it would of itself be a mark of incompetence that he did not know how to employ them.

SIR,—I think we should all have a better idea of the points at issue if we had more facts. At present these seem to be very scarce. May I ask any of your naval engineer correspondents to supply some information of the following kind:—

How many hours is any battleship or cruiser—no matter which—under steam in any one year?

For how many hours is she steaming at one-quarter, one-half, and three-quarters horse-power?

I suppose the facts are on record, and can be readily obtained. If it is not considered expedient to publish her name, that might be given to you, Sir, in private, and some fancy name adopted in the reply to this letter.

Sunderland, December 10th. J. HOLLEY.

ENGLISH RAILWAY STATISTICS.

SIR,—Complaints are frequently heard about the reduced dividends that are now being paid by several of the English railway companies. The managers put this down to the higher rates paid for labour, and the rise in price of fuel and other supplies, while numerous suggestions have been made to raise the rates on freight to create more revenue.

These matters tend to show the immediate necessity of going more into detail as to the volume and distance the traffic is carried. English railway managers are unique in their system of showing the tonnage of goods, and number of passengers carried, without regard to the distance hauled.

The American companies, in their fierce competition, find it is necessary to know this, and work out the statistics accordingly. This question is summed up by the statistician to the Interstate Commerce Commission as follows:—"Two conclusions may be drawn from this recognition of the erroneous character of certain statements contained in the above summaries: First, the true units of transportation are the number of passenger miles and ton miles accomplished, and not the number of passengers and tons carried. All important countries, England alone excepted, acknowledge this to be the only basis of safe comparison in railway statistics."

In referring to similar particulars during the earlier years in the United States, Mr. H. T. Newcomb * states the following:—"The possibility of collecting more complete information for the later years shown is attributable not so much to the destruction, owing to the lapse of time, of the records of the earlier years, as it is to the progressive improvement in methods of railway accounting, which, while due in some measure to the requirements of regulative legislation, is in a large degree a consequence of the increasing importance assigned to statistics of the results of the operations of railway properties by the most practical and competent among railway officials and the investing public. This is particularly to be observed in connection with the means of measuring the services performed in the movement of property by establishing the ton moved one mile as the unit of freight services, and reducing all transportation of commodities to that basis."

At the present time the English companies compile their returns on the Board of Trade requirements authorised in the year 1868, and although conditions of traffic have altered so considerably, no change has been made in compiling the schedules. From the official returns, the volume of traffic that was carried in the two countries named for a year, was as follows:—

	United States. Year ending June, 1898.	United Kingdom. Year ending December, 1899.
Passengers carried	501,066,681	1,106,691,991
Goods and livestock, tons	879,006,307	413,623,025
Revenue from passengers	£55,618,852	£.6,782,772
Revenue from goods and live stock	£182,651,608	£52,116,994
Average earnings per passenger	2s. 2·54d.	7·25d.*
Average earnings per ton of goods	4s. 1·87d.	2s. 6·24d.
Average journey per passenger, miles	26·70	not known
Average haul per ton of goods, miles	129·78	not known

* Exclusive of season-ticket holders.

The extraordinary difference in the average earnings per passenger and per ton of goods shows the necessity for further inquiry. It is universally admitted that the goods rates in America are considerably lower than in England, yet the earnings per ton average 65 per cent. more than in England. This points to the fact that the length of haul must be considerably longer in America, as would naturally be supposed.

Another point to be borne in mind owing to the absence of ton-mile statistics: What is the average weight of revenue earning freight per train? No doubt a considerable difference would be shown as compared with the United States, and that the increased train miles to move the same tonnage over the same distance would account for a large portion of the increase in working expenses.

As no system has yet been devised, not even approximately, to ascertain the cost of transportation of various classes of freight, the only means of judging as to whether one class of traffic is paying better than another is by inference on the revenue earned per ton-mile. The same terminal cost will apply to a certain class of traffic, whether it is carried 10 miles or 100, while the net earnings will increase the longer the distance the traffic is carried.

In the passenger traffic the difference between 2s. 2½d. and 7¼d., average earnings per passenger, is remarkable, and although several causes may be mentioned to explain a slight difference, still the wide margin between the two is unaccountable on the figures obtainable.

One point is deserving of special investigation—that is, the ratio between passenger and goods earnings in each country. In the United States the ratio is 2 to 1, while for the United Kingdom it is over 4 to 1 in favour of goods, while the train miles in the United States is as 1·48 to 1, while in England the passenger service is the highest at 1·23 to 1.

Losses on one class of traffic may be compensated for during the year by extra profits derived on another class, while in another year a good profit-earning traffic may be reduced in tonnage or distance carried, and a lower paying traffic increased, thus causing a considerable reduction in net earnings, although the total tons carried may be the same. Where particulars are compiled the information of these fluctuations are interesting. A table is given below showing the difference in traffic on the New South Wales railways for the years 1891 and 1900.

	Year.	Tons carried.		Average haul.		Revenue.		Earnings per train-mile.	
		Tons.	Increase p.c.	Miles.	Increase p.c.	£	Increase p.c.	d.	Decrease p.c.
Grain and flour	1891	198,491	—	111·49	—	61,521	—	0·66	—
	1900	361,052	82	169·95	22	142,945	132	0·56	15
Hay, straw, and chaff	1891	64,967	—	154·29	—	19,797	—	0·46	—
	1900	118,631	83	176·39	14	29,714	50	0·34	26
Wool	1891	111,797	—	270·86	—	314,151	—	2·49	—
	1900	84,678	24 (dec.)	247·30	9 (dec.)	203,594	35 (dec.)	2·33	6
Live stock	1891	128,211	—	270·26	—	267,661	—	1·85	—
	1900	188,595	47	243·88	10 (dec.)	295,798	10	1·54	16
General merchandise	1891	1,008,599	—	91·30	—	806,382	—	2·10	—
	1900	1,166,966	15	95·07	4	849,823	5	1·84	12

Lindfield, N.S.W., November 5th. P. HOWELL, F.S.S.

CONSULTING ENGINEERS.

SIR,—Your article in your issue of the 7th inst., on "Foreign and English Practice in Electrical and Technical Industry," deals somewhat hard measure to consulting engineers. You criticise the name, and here I think you have some reason. A "Consulting Engineer" usually does not correspond to a "consultant" in the medical profession, for example, that is to say, as a man of necessarily larger experience and attainments than the ordinary general practitioner. The title "Consulting Engineer" is certainly somewhat misleading, though it is slowly getting to be understood, just as the term "civil engineer," though at first intended to differentiate from a "military engineer," is now popularly understood to be a title denoting an engineer who designs railways, canals, docks, and the like, such designs being executed by contractors, as the designs of an architect are by builders. A consulting engineer occupies, or should occupy, the same position with regard to engineering as the architect does with regard to building. I entirely fail to see why the system which works so well in building, and in the construction of great public works, should not operate equally well in mechanical and electrical engineering.

If a person is about to spend several hundreds or thousands of pounds in building, he goes to an architect in the first instance as a matter of course, for him to prepare plans and designs. He would not go straight to a builder except for some small or unimportant work. But if an ordinary factory owner wants to lay down engines, boilers, electric light or power, or any description of mechanical plant, he usually goes directly to a manufacturing engineer, ignoring the consultant. I use the word "ignoring" advisedly, as in most cases persons are really ignorant of the advantages that they would secure by employing a consulting engineer. This applies more than ever now-a-days, when the choice of the means of driving and lighting works is so much more varied than formerly. A consulting engineer, or engineering architect as he might be called, will, if he knows his business, be able to advise his clients generally as to the best kinds of plant for the particular purpose in view, and will readily grant that each manufacturing engineer is a specialist in his own particular branch. The judicious consulting engineer will therefore not hamper the manufacturing

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* In "Changes in the Rate of Charge for Railway and other Transportation Services," published by the United States Department of Agriculture.

engineer by "fads" in his specifications, but will, by specifying standard types of plant, best consider his clients' interests.

Without the consulting engineer the ordinary factory owner is very much at the mercy of the agents of manufacturing engineers, who each naturally try to get him to buy the goods that they have to sell. Large manufacturing—not engineering—concerns often have an engineer employed, at a high salary, to act for them exclusively, but smaller firms, who have not sufficient work to keep a highly-skilled engineer permanently employed, would, in my opinion, be well advised to place their engineering requirements in the hands of a consulting engineer.

W. H. THORNBERY, M. I. Mech. E.

Birmingham, December 10th.

CENTRIFUGAL PUMPS.

SIR,—In the issue of your valuable paper of November 30th, in the review of Mr. Henry Davey's book on "Pumping Machinery," there occurs a remark which interests me very much.

Referring to centrifugal pumps, the reviewer says it is doubtful whether those pumps act by centrifugal force, or whether they merely impart speed to the liquid, and thereby create kinetic energy which is gradually translated into static energy or pressure. For many years past I have been convinced of the correctness of the second proposition, and I hold that perfect centrifugal pumps should impart tangential motion only to the liquid, and I construct my pumps on that basis. As the liquid enters by the centre, and is discharged at the periphery, it must have a certain amount of radial or centre-flying motion. But that is only a secondary result, and all energy created by that motion is detrimental to the efficiency of the pump, as it is in the way of the proper course of the liquid. To have given the name of "centrifugal" to such pumps was like calling an engine "condensing" by virtue of the amount of steam condensed on its surfaces without doing any work. It would hardly be thought a commendation. Though it may be too late to change the name, there can be no reasonable doubt that these pumps are tangential pumps, and the more nearly they comply with that conception the more efficient they will be.

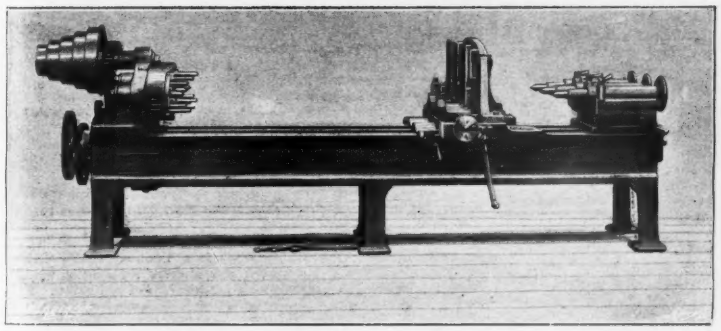
The system of combining pumps in series for raising liquids to great heights is, as you say, of ancient date, and I remember experiments made in that direction more than forty years ago. In many situations the combination is highly efficient, and calculation in effect shows that several pumps working thus together in succession are more economical of power than a single pump of the same capacity raising liquid to the same elevation.

96, Newgate-street, London, E.C., JOS. BERNAYS, M.I.C.E.
December 8th.

THREE-SPINDLE LATHES.

SIR,—Referring to the splendid Machine Tool Supplement in your issue of last week, I would like to mention that the three-spindle lathe shown on page ii. is, with the exception of the inverted Vees on the top of the bed, an almost exact copy of a lathe that has been made by Tangyes' Machine Tool Company for many years—see photograph herewith.

Originally I believe it was designed by one of those well-known engineers, Mr. James or Mr. Joseph Tangye, and I understand such lathes have been used by Tangyes Limited, of Birmingham, for more than thirty years. Several of them have been supplied



to users in England—including the London and North-Western Railway, who have several at Crewe Locomotive Works—and also abroad. It is probable that the design shown in your supplement has been practically copied from one of the latter.

As you say on page i., the quick withdraw motion used on this lathe is not by any means new; for more than twenty years it has been fitted to almost all the screw-cutting lathes made by Tangyes' Machine Tool Company, Limited. It is probably thirty years, or even more, since Mr. Joseph Tangye first applied it to lathes in the Tangye Works, and I believe it is also used by several other well-known machine tool makers. C. P.

November 27th.

VENTILATION AND HEATING.

SIR,—Is it not desirable to keep ventilation and heating, for ordinary buildings at least, as simple as possible? For this reason a vertical shaft at the top of a room with a lamp under it would seem to be preferable to a fan. The air could be introduced through another vertical shaft, and the apparatus for treating it should be simple also; but especially should any heating surface be of large extent and of very moderate temperature. It would probably conduce to satisfactory working to make every room virtually independent, with straight and ample ducts.

London Institution, E.C., ALFRED J. ALLEN.
December 7th.

THE MOLECULAR CONSTITUTION OF WATER.

SIR,—I would like to call the attention of your readers interested in the physics of water to an important investigation by William Sutherland, of Melbourne, communicated in the *Philosophical Magazine* for November last. He thinks that sufficient data is in existence to enable one to work out quantitatively the actual constitution of water, and shows that steam being H_2O, ice is pure $(H_2O)_3$, and water a mixture of $(H_2O)_3$ and $(H_2O)_2$ in proportions whose dependence on temperature can be expressed by a simple formula. As H_2O is very generally used as a symbol for water, and as hydrogen oxide is a long name for so important a chemical species as H_2O, he proposes for international convenience to call H_2O hydrol, $(H_2O)_2$ dihydrol, and $(H_2O)_3$ trihydrol. Steam is hydrol, ice is trihydrol, and water a mixture of dihydrol and trihydrol.

The investigation includes the following:—Constitution of water from its thermal expansion; confirmation from its optical refraction; compressibility of water and dissociation of trihydrol into dihydrol by pressure; surface tension and constitution of water in surface film; latent heat of fusion, specific heat, and latent heat of evaporation; the viscosity of water; dielectric capacity; the melting of ice as a phenomena of dissociation, and the higher valency of oxygen; and summary of results.

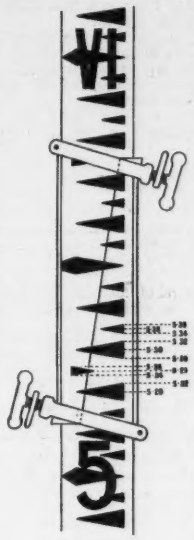
He says in his summary of results, that probably at its critical temperature water is practically pure dihydrol; that the latent heat of fusion of ice is not an ordinary physical latent heat of fusion, but is mostly a latent heat of dissociation of trihydrol into dihydrol, partly masked by heat of solution of trihydrol in dihydrol. The latent heat of evaporation of water includes also the heat of dissociation of the dihydrol and trihydrol of water into the hydrol of steam; that the specific heat of water is not an ordinary specific heat, but includes a certain amount of heat dissociation; and that pressure dissociates trihydrol, at rates given in a table.

The paper extends to some thirty pages of matter, every bit of which is worthy of the most careful consideration and study.

19, Claremont-square, JAMES C. RICHARDSON.
December 4th.

LEVELLING STAFF.

SIR,—In your view of Mr. Walmisley's book, "Field Work and Instruments," you advocate the use of a levelling staff with as few markings as possible, and with no figures except at the feet. The Scotch staff has generally only got the tenths and half-tenths of a foot indicated, and the only figures are at the feet. It is not made on the telescopic principle, but is in three separate lengths jointed together when in use. Much can be said in favour of the Scotch staff, both regarding its form and its graduations, though those accustomed to a Sopwith staff graduated to hundredths of a foot think that too much is left to be estimated between the markings.



The style of painting shown in the illustrations has all the clearness of the ordinary Scotch staff, and yet leaves unmarked in no case more than one-hundredth of a foot. The staff shown in the illustration, being intended for stadia work as well as for levelling, has on one edge the alternate feet painted red, like a ranging pole.

It seems a pity that the custom is not more universal of distinguishing by Roman numerals only the figures VI. and IX. There is no reason for making the 5, 10, and 15 Roman.

G. W. HERDMAN.
December 10th.

ON THE SUPERSESSION OF THE STEAM BY THE ELECTRIC LOCOMOTIVE.

SIR,—I have read your courteous article on my paper dealing with the above subject with much interest. There are many points which I would like to answer, but I will ask you to do me the favour to allow me to defer doing so at the present moment. The paper is to be discussed by the Glasgow section of the Institution of Electrical Engineers during the present week, and on the conclusion of the discussion I hope to be in a position to consider, not only the comments of those who have been good enough to enter into the subject, but points advanced by the senior technical journals. As soon as possible thereafter, I will ask your permission to again bring the subject under your notice—not for the purpose of enlisting sympathy or attracting attention, but for the reason that I think it possible I may, in my further observations, place many of the points on which you have so courteously commented upon in your article in a clearer and more definite form before you. In the meanwhile may I be permitted to point out that the saving (£260,000) quoted in your article refers to the entire Midland system, and not to the London-Bedford section only?

The paper makes two comparisons in respect of cost. That to which you refer applies to a comparison with the *average* annual working cost, extended over a period of 24 years. The further comparison is with the year 1899, when the cost stood at 10·218d. per train mile—a point to which it had been gradually advancing for some years, by no means exceptional to the Midland, for, as your readers will see on reference to the data furnished by me, the average cost to the six large railway companies was 10·267d.

I venture to hope that you may, on the completion of my paper, be able to resume your consideration of the subject under the additional light to which my comments may in your opinion entitle it.

Derby, December 11th. W. LANGDON.

THEODOLITES AND THEIR FAILURE.

SIR,—Quite lately I bought an 8in. transit theodolite, reading to 10 sec., and with three levelling screws, from a well-known London firm. At first the instrument was all that could be desired, but I find now in taking an angle from left to right, and the same angle from right to left, I can make a difference of twenty, and sometimes thirty seconds. The fault, as far as I can make out, lies in the three levelling screws, which "give" when the vernier plate is moved, and this although they were tightened up with the small screws for that purpose.

I had the same difficulty some years ago with a 6in. instrument of the same pattern, and could never get any remedy for it, except the partial one of keeping the axis of the vernier plate well oiled, so as to have as little friction as possible between it and the bottom plate.

The instrument has been sent to the maker for adjustment, and will be returned, I have no doubt, with the defect still there and the usual assurance that it is all right now.

Perhaps some of your readers have had a like experience with theodolites of this pattern, and can suggest a way of getting over the difficulty. W. J.

December 1st.

A REMARKABLE OLD WATERWAY.

SIR,—Your correspondent, Mr. Tyeth D. Bounsall, will find an account of the canal he alludes to in THE ENGINEER of December 25th, 1896. Drawings of the lifts on it are given in "The Rudiments of Civil Engineering," by Henry Law, Part II., pages 83 to 89, and more elaborate plates and description are in the "Transactions" of the Institution of Civil Engineers, vol. ii., page 185.

Chelsea, S.W., December 8th. W. B. PALEY.

THE EFFICIENCY OF FANS.

SIR,—I do not think I can do better than refer Mr. Grainger to an article on fans written by Dr. Oliver Lodge, and published in THE ENGINEER for January 4th, 1889. There is no explanation given of the difference in pressure, nor is there anything about inductive action directly. But the whole article is so complete, that, before proceeding further, Mr. Grainger ought to master its contents.

December 8th. P. W.

ON THE SUPERSESSION OF THE STEAM BY THE ELECTRIC LOCOMOTIVE.*

By W. LANGDON, Vice-president.

(*Continued from page 572.*)

FIG. 1 illustrates the section of line under consideration. The position of engine sheds is shown by stars (*); of water cranes by dots (·). The short or suburban traffic between St. Pancras and Hendon, and the Tottenham line, &c., is not included in my schedules, for the reason that, viewing the section of line as if actually subject to electrical working, there would be little doubt that this immediate London-suburban traffic would demand a generating station nearer home than that indicated in the scheme I have adopted as my basis for the comparison of costs for working a fifty-mile section of line.

The plant scheme is roughly outlined in Fig. 2. Midway in the fifty miles of railway is the central station, containing four 2500-kilowatt, three-phase, or other characteristic, 10,000-volt generators. At this pressure current is distributed to sub-stations,

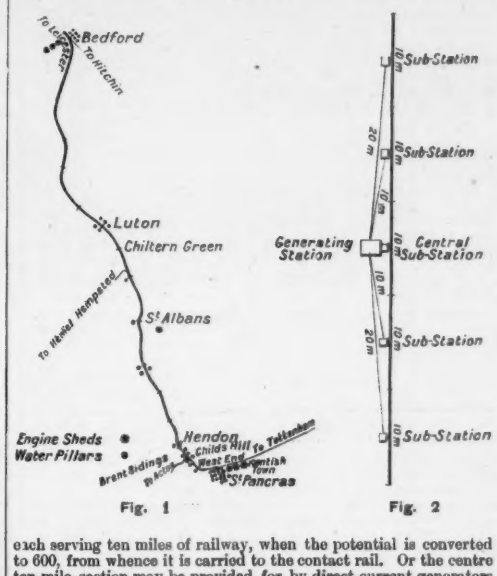


Fig. 1

Fig. 2

each serving ten miles of railway, when the potential is converted to 600, from whence it is carried to the contact rail. Or the centre ten-mile section may be provided for by direct-current generators served from the same steam plant.

The efficiencies of the various parts are assumed as follows:—

	Loss per cent.	Efficiency.
Motors	15	·85
Ohmic loss in rails	10	·90
Leakage	2½	·975
Rotary converters	10	·90
Static transformers	7	·93
H.T. transmission	10	·90

The total kilowatts required on the train wheels (Table IV.) is 2905 per hour, and the number of trains is fourteen. Therefore $\left(\frac{2905}{14}\right)$ 207·5 will be the average kilowatts per train hour; and assuming the efficiency of the motors at 85 per cent., $\left(\frac{207·5}{·85}\right)$ 244 kilowatts will be the average power required to be supplied to each train. If, now, we allow 10 per cent. loss in the rails which supply and return the current, a pressure of 540 only will be available at either end of a section of ten miles. Therefore the ampères per train that will be required will be $\left(\frac{244 \times 1000}{540}\right)$ 452.

As there are fourteen trains per hour in the total fifty-miles section, there will be $\frac{14}{5} = 2·8$, say three trains in one section of ten miles to be supplied by one sub-station.

$$452 \times 3 = 1356 \text{ ampères.}$$

Adding 2½ per cent. for leakage, we have 1390 ampères as the current to be supplied by each sub-station at 600 volts. The efficiency of the converters and static transformers is taken at, respectively, 90 per cent. and 93 per cent., and the three-phase transmission at 90 per cent.

$$\therefore \frac{1390 \times 600}{1000 \times ·9 \times ·93 \times ·9} = 1107 \text{ kilowatts to be delivered to}$$

the trains for each section containing three trains.

As there are fourteen trains, there will be four sections with three each, and one section with two trains.

Now the four sections with three trains each would require:—

$$1107 \times 4 = 4428 \text{ kilowatts.}$$

To allow for the maximum loss, let it be assumed that the centre ten-mile section, which, as previously indicated, might be supplied direct at 600 volts, is so dealt with, and that it is the section that has two trains only.

The kilowatts required would equal:—

$$\frac{1390 \times 600}{1000} \times \frac{2}{3} = 556 \text{ kilowatts.}$$

Therefore the total kilowatts to be generated would be—

$$(4428 + 556) = 4984, \text{ say } 5000,$$

and the combined efficiency $\left(\frac{2905}{4984}\right)$ would be 58·3 per cent.

This 5000 kilowatts is the power required to be generated to work the fourteen trains, travelling 479 miles during the hour, as shown in Table IV., and upon it all comparative calculations and deductions have to be based.

The demand may, of course, go beyond this, or it may be less, but so long as the generating power, and that of the corresponding parts, is there to meet it, that branch of the question may be disregarded. As I have previously stated, the comparison is made between the ascertained quantities travelling a stated mileage at a stated speed. If the mileage were greater, or the number of trains greater, the comparison would be equally applicable. It is, in respect of the mileage result, immaterial, so long as we apply it to a fairly representative condition. The speed and the train load indicated in Table IV. will, I believe, bearing in mind that the number of trains are regarded as all carrying the full load indicated, be found to conform to this.

A generating plant capable of an output of 10,000 kilowatts is of course, ample to provide for a calculated demand of just half

* Institution of Electrical Engineers, read November 29th, 1900.

that amount. I adopt the following estimate as applicable to the prime cost:—

Generating Station.

	£	£
Buildings, foundations, chimney stacks, &c.	50,000	
Equipment, including steam units, boilers, coal conveyors, steam mains, condensers, pumps, &c.	200,000	
		250,000
Sub-stations.		
Buildings—five stations	10,000	
Equipment of ditto with transformers, converters, &c., delivering at 600 volts, and all necessary fittings	70,000	
		80,000
Cables, including laying	70,000	
Contact rail—200 miles (*i.e.*, four roads of 50 miles each)	70,000	
		140,000
Total capital outlay for generation and distribution of current		470,000

The figures comprised within the two first items are practically those given by Mr. Parshall with reference to a somewhat similar plant, with the exception that the amounts have been increased to the extent of £15,000 for the generating station equipment, consequent upon the adoption of a higher voltage; and £10,000 for generating station buildings to meet any advance of prices. £10,000 has also been added for independent transformer buildings. The cost of cables, including laying in position, is based upon the current demand and mileage.

The hourly demand has been shown to be 5000 kilowatts. The annual output for the section of line under consideration will therefore be this amount multiplied by the twenty-four hours per day, and 365 days to the year, viz., 43,800,000 kilowatt-hours.

On this basis I estimate the annual cost for generation and distribution of current, as shown in the annual column of the following table, from which, by dividing the sums there shown by the annual kilowatt output, I obtain the per kilowatt-hour charge.

To the foregoing we have to add the cost for drivers and assistants in attendance upon the electric locomotives—performing practically the same duties as the driver and firemen in attendance upon the steam locomotive; together with that for repair and renewal of all machinery, including the locomotives.

In his presidential address to the members of the Institute of Mechanical Engineers in 1898, Mr. S. W. Johnson, the locomotive engineer for the Midland Railway, furnished valuable data in relation to the cost of moving railway trains. From this data I, by his courtesy, am enabled to furnish the details shown on Table VI.

Table V.—*Estimated Cost of Generation and Distribution of Current.*

Details of charges.		Per annum.	Per kilowatt-hour.
		£	Pence.
1. Capital outlay, £470,000. Interest at 3½ per cent.		16,450	0·0901
2. Generating station—			
Salaries and wages:	£		
1 chief engineer	500		
1 assistant ditto	250		
3 switch-room attendants, at £150 each	450		
1 clerk	120		
7 engine-room attendants, at 40s. each per week	728		
7 assistant ditto, at 35s. each per week	637		
12 stokers, at 30s. each per week	936		
15 labourers and cleaners, at 22s. each per week	858		
		4,479	0·0245
Coal— At 3·0 lb. of coal per kilowatt-hour—58·667 tons, at 7s. 11½d. per ton		23,345	0·1279
Water— At 25 lb. per kilowatt-hour, and 2d. per 1000 gallons		913	0·0050
		28,737	0·1574
3. Sub-stations (5)—			
Salaries and wages—	£		
5 assistant engineers, at £200 each	1000		
	2080		
	1820		
	572		
		5,472	0·0299
4. Outdoor service— 5 rail jointers and fitters at 40s. each per week	520		
Material, &c.	230		
		750	0·0041
5. Oil, waste, and sundries		2,000	0·0109
Total estimated cost of generation and distribution of current		36,959	0·2023

Table VI.—*Steam Locomotive Charges.*

Average Midland Railway total locomotive expenditure, &c., during twenty-four years, 1873-96.	£	Cost per train mile. Pence.
Running expenditure—		
Wages—Drivers and firemen	358,635	2·650
Cleaners, coalmen, &c.	94,422	0·698
Water	28,575	0·211
Oil and stores	44,842	0·331
Coal and coke	289,595	2·139
Total running expenditure	816,069	6·029
Repairs and renewals—		
Wages	178,718	1·320
Materials	178,742	1·321
Total repairs and renewals	357,460	2·641
Salaries	24,187	0·179
Turntables and buildings	2,861	0·021
Gas	9,868	0·073
Gross expenditure	1,222,899	8·943
Tons of coal and coke consumed	727,889	
Cost per ton	7s. 11½d.	
Train mileage	32,485,530	

This table shows that the average cost for twenty-four years, for drivers and firemen was £358,635, or 2·650d. per train mile; and that for repairs and renewals, £357,460, or 2·641d. per train mile.

To arrive at the cost for drivers and attendants for the electrical locomotive, I might revert to Table IV. and deduce from it, at a given rate of wage per hour, for the number of trains occupying the line for that period, the kilowatt-hour cost, but this, it appears to me, would not be quite right. There can be no question that the cost incurred by the locomotive department is extremely heavy,* but it is a charge incumbent upon the working of the traffic, and whatever are the conditions which militate against a reduction in this charge with the locomotive department, presumably they would hold good against the electric unless the traffic could, under the latter, be so facilitated as to enable it to be got through with greater speed, and less shunting. It is not clear this could be done. I am therefore, very reluctantly I must admit, obliged to adopt the extremely heavy cost incurred by the steam locomotive, for there would be very little, if any, difference in the rate of pay to the respective class of men.

The repair and renewal of electrical machinery, whether in relation to the generating or the locomotive plant, should be considerably less than that of the steam locomotive plant, for the reason that there will be extremely few moving parts, while many small units, used for pumping and other like purposes, would be provided for from the central generating station at a less cost, or entirely abolished.

The train mileage—Table IV.—run by the fourteen trains during one hour, is 479. Assuming that the cost attending the repair and renewal of the electrical machinery will be 2d. per train mile, as against that for the steam locomotive power and works, viz., 2·641, we shall have a result of 0·1916d. per kilowatt-hour.

There is yet one more addition to make. The cables and contact rail are peculiar to the electrical system. I do not include them in the above 2d. per train mile for repair and renewal of machinery. Having regard to the value of the recovered material, I assume 2½ per cent. on the primary outlay will meet the renewal of cables, and 4 per cent. that of the contact rail. This means 0·0249d. per kilowatt-hour.

Table VII. furnishes all these items, against each of which is also shown the cost per train mile, *i.e.*, the cost per kilowatt-hour multiplied by the total output, viz., 5000 kilowatts for the hour's work, divided by the train mileage worked during the hour, viz., 479.

Table VII.—*Electrical Charges. Cost in Pence per Kilowatt-hour and per Train Mile.*

	Per kilowatt-hour.	Per train mile.
Generating charges	0·1574	1·645
Sub-station charges	0·0299	0·312
Outdoor attendance	0·0041	0·043
Oil, waste, and sundries	0·0109	0·114
Locomotive drivers and assistants. [This item is shown at the cost incurred under present mode of working]	0·2538	2·650
Repair and renewal of machinery, motors, &c.	0·1916	2·000
Renewal of cables and contact rail	0·0249	0·259
Total cost for power and haulage	0·6726	7·021
Interest at 3½ per cent. on primary outlay, viz., £470,000	0·0901	0·941

Therefore, if my deductions are correct, it would appear that the cost of working by electricity as against that for the steam locomotive is, per train mile, so far as the Midland is concerned, as 7·021d. to 8·943d., being an apparent saving of 1·922d. per train mile, or £260,155 on the average yearly cost for the twenty-four years indicated. A closer comparison of the chief items may help us to learn where and how so large a saving is effected.

Coal stands in Mr. Johnson's data at 727,889 tons, at a cost of £289,595. Based upon the figure adopted by me, viz., 3·0 lb. per kilowatt-hour, the tonnage required is 454,145,† and the money £180,712.‡ The steam locomotive consumes on the average 50·191 lb. of coal per train mile. My figures place the quantity required for electrical energy at $\frac{(5000 \times 3{\cdot}0)}{479}$ 31·315 lb. The saving under this head is, therefore, 273,744 tons, which at 7s. 11½d. will account for £108,927. We have to bear in mind that the calculation on which the cost of electricity is based makes no provision for shunting operations. It is based entirely upon the train mileage run. Shunting work is, of course, included in Mr. Johnson's figures, and will account, to some extent, for the difference. The main gain, however, is to be found in the economy of a stationary, as against an itinerant generator, as well as in the fact that much coal is consumed by goods and mineral trains when shunted, and by all trains when standing at stations, the whole of which would be saved if worked by electricity.

With stationary engines a less expensive coal than that used for locomotives would be available, thereby effecting a reduction probably more than sufficient to meet the cost of shunting previously alluded to. It may be pointed out that coal is more costly at present. Such is the case, and, were my calculations based upon the present rate of coal, the result would largely enhance the advantage of electricity. Say, for instance, that coal stood at 10s. instead of 7s. 11½d., the locomotive cost would be 727,889 tons at 10s. = £363,944 instead of £289,595. That for electricity would be 454,145 tons at 10s. = £227,072 instead of £180,701. The result would be that electricity would show, under coal at 10s. a ton, a saving of £136,872 instead of £108,927, on precisely the same mileage, with a proportionate increased saving at prices ranging above that figure.

The fact that dear coal enhances the comparative value of an electrical system—especially with the possibility of coal at a higher rate than 7s. 11½d.—cannot be too strongly emphasised.

(*To be continued.*)

The Society of Engineers.—The annual dinner of this Society was held at the Hotel Cecil on Wednesday night. Mr. Henry O'Connor, the president, occupied the chair, and there were also present Colonel H. Barron, R.A., Lord Rosmead, Professor H. Robinson, Mr. Perry Griffith, vice-president; Mr. George Burt, hon. secretary and treasurer; Mr. Charles Mason, president-elect; and Mr. Perry F. Nursey, secretary. The President, responding to the toast of "The Society of Engineers," acknowledged the gift of a valuable president's badge of office, which had been made during the year by Mr. George Burt, the hon. secretary and treasurer. He stated that the Society numbered over 500 members. Replying to the toast of "The Imperial Forces," Colonel Barron spoke of the importance of providing adequate harbour accommodation for the Navy.

Royal Institution.—The following are the lecture arrangements at the Royal Institution, before Easter:—Sir Robert Ball, six lectures—adapted to young people—on "Great Chapters from the Book of Nature"; Professor J. A. Ewing, six lectures on "Practical Mechanics—experimentally treated—First Principles and Modern Illustrations"; Dr. Allan Macfadyen, Fullerian Professor of Physiology, R.I., four lectures on "The Cell as the Unit of Life"; Dr. Arthur Willey, three lectures on "The Origin of Vertebrate Animals"; the Rev. H. G. Graham, three lectures on "Society in France before the Revolution;" Sir Wyke Bayliss, two lectures on "Shakespeare in Relation to his Contemporaries in Art"; Professor R. K. Douglas, two lectures on "China"; Mr. F. Corder, three lectures on "Vocal Music: Its Growth and Decay"—with musical illustrations; the Right Hon. Lord Rayleigh, six lectures on "Sound and Vibrations." The Friday evening meetings will begin on January 18th, when a discourse will be delivered by Professor Dewar on "Gases at the Beginning and End of the Century"; succeeding discourses will probably be given by Dr. A. W. Ward—the Master of Peterhouse—the Right Rev. Monsignor Gerald Molloy, Professor G. H. Bryan, Professor J. J. Thomson, Sir W. Roberts-Austen, Mr. H. Hardinge Cunynghame, Mr. W. A. Shenstone, Dr. Horace Brown, the Right Hon. Lord Rayleigh, and other gentlemen.

* Assuming the weekly wage of driver and fireman to amount to 90s., probably an excessive sum, it would seem that the weekly mileage travelled would be but 407. If the wage were 70s., the mileage would be but 317.

† $\frac{5000 \text{ K.W.} \times 3{\cdot}0}{479} = 31{\cdot}315 \frac{32{,}485{,}530 \times 31{\cdot}315}{2240} = 454{,}145$ tons.

‡ $\frac{{\cdot}1279^{\text{d}} \times 5000 \text{ K.W.}}{479} = 1{\cdot}335073^{\text{d}}$ per T.M. 32,485,530 T.M. × $1{\cdot}335^{\text{d}}$ = £180,711.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.

Professor R. H. Smith delivered on the evening of December 6th the second part of his paper upon steam engine valves and valve gearing to the Civil and Mechanical Engineers' Society, at the Hotel Victoria, Northumberland-avenue. In the first part of the lecture he had pointed out that, in each double-acting steam cylinder, eight points of steam distribution and the size of the port area ought to be determined independently of each other, while the ordinary excentric-driven single-slide valve afforded only five independent elements of design, while with a Meyer's cut-off slide on the back of the main slide there were really more elements at the disposal of the designer than he could make use of. He had classified slide and lift valves into ten classes, and had illustrated these and their sub-classes by drawings shown with the aid of the lantern. He had recommended separate admission and exhaust valves rather than separate main and cut-off valves, and had shown that trip gears are as applicable to slide valves as to lift valves, being, indeed, earliest applied to Corliss valves, which were really slide valves. On the 6th inst., after showing diagrams of various forms of link motion and of trip gears, and describing their relative advantages, especially as regards the stresses in their members and the wear at their joints, he said that it was impossible in practice to follow Rankine's rule of designing the port area for the same steam entrance velocity in all cases, and that there seemed to be no good scientific grounds for recommending it. He showed on the screen a rule which gives nearly the same drop of pressure by wire-drawing in all cases, and which agrees fairly well with what is found practicable in low and high-speed engines; and also showed that Rankine's rule, if followed, would make the percentage of cylinder power spent in driving an unbalanced slide valve increase as the square of the piston speed, and also as the ratio of cylinder diameter to stroke. In order to avoid excessive waste of power in driving valves and valve gears, he advocated not only the complete balancing of valves of all kinds, but also their direct steam driving, and suggested that simple forms of valve gear might still be retained for guidance to the correct timing of the cut-off, while the actual driving power would not be transmitted through the gear. He then showed a number of diagrams, which greatly facilitate the labour of designing harmonic valve gears. He discouraged the use of Zeuner's valve diagrams, as tending needlessly to obscure and confuse what was an extremely simple problem, which, he said, only required a little clear thought and the most elementary mathematical common sense to deal with easily, either with or without the help of diagrams or other graphic methods. He would have been glad to deal with graphic constructions for finding nearly accurate "corrections" of the so-called "errors" in various forms of "radial" valve gear, but time did not permit of this.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The near approach of Christmas is not favourable to an increase of business in the iron or coal trades. Consumers are contenting themselves with buying from hand to mouth, and this condition of the market is certain to continue into next year. So long as prices alike of iron and coal show the downward tendency which is at present so marked, buyers cannot be expected to order in anything but very small lots. This week's meetings of the trade, both at Wolverhampton yesterday and at Birmingham to-day—Thursday—therefore had about them a very inferior air; what business was done was more a matter of asking and obtaining quotations rather than actual buying and selling, and negotiations had about them more of an anticipatory character for 1901 than much actual intention of immediate purchasing.

Prices were easy in all directions. Indeed, when asked what their prices were, sellers very generally responded, "What we can get." This declaration summarises in a nutshell the present position, and ironmasters may be deemed wise in taking this course. It is impossible to fight against the fall which has now set in, and it is altogether much wiser to accept the inevitable with the best grace that may be. The sooner now prices get down to a reasonable level, if not, indeed, to rock bottom, the better for all concerned. Prices this—Thursday—afternoon in Birmingham were quoted at, for common bars, £8 and upwards. It is not improbable that an early meeting of the Unmarked Bar Makers' Association may be held to consider the question of a further official reduction. Any decision which may be made in the future has been, however, already discounted, North Staffordshire bars having been brought down to £8 to £8 5s., Lancashire to £8, and Middlesbrough to £8; the local makers have adopted the same figure, though the Association standard remains nominally unaltered.

Marked bars remain at £10 10s., with Earl Dudley's brand £11 2s. 6d., and second-grade bars £9 15s. Some of the "list" houses have a steady inflow of small orders, but others are not so well supplied. It is, however, doubtful if any alteration will be made before next quarter-day, as the cost of manufacture continues to be so heavy.

An aid to the "slump" in prices at date is the expectation that still lower values will be quoted at the January quarterly meetings—an impression which, in the absence of the miraculous, is almost certain to prove correct. Lower official prices of both foundry iron and pig iron will almost certainly rule at these gatherings, and consumers cannot be complained of for temporarily standing off the market. Hoop iron is quoted at date £9 to £9 10s., nail rods and rivet iron £8 10s. to £9 5s., and gas-tube strip £8 to £8 15s.

The black sheet trade is in an unsatisfactory position owing to the restriction of orders from the galvanisers. For the galvanisers themselves, the position is very trying. The trade passing is not more than normal, and this, in comparison with the recent rush of business, is naturally disappointing, particularly as it is believed that the moment South Africa is again freely opened up to trade a great rush of orders of substantial weight will be experienced. Under present circumstances quotations show a decline, and the figures given are to some extent nominal.

Current prices are named as:—Sheets, singles, £8 10s. to £8 12s. 6d.; doubles, £8 12s. 6d. to £8 15s.; trebles, £9 5s. to £9 7s. 6d.; galvanised corrugated sheets, f.o.b. Liverpool, £12 5s. to £12 10s.

The steel trade maintains its position better than iron, but even here a decided shrinkage is seen both in the volume of business coming forward and in the realised selling prices. Current rates are quoted on the open market at: Bessemer billets, £5 10s. to £5 15s.; best Siemens ditto, £5 15s. to £6; mild steel bars, £8 5s. to £8 15s.; steel plates, £8 to £8 10s.; steel girders and angles, £8 to £8 5s.

Pig iron is without strength; indeed, the position of this metal is getting weaker and weaker as the year draws to a close. It is felt that more furnaces must be blown out unless prospects speedily improve. Three furnaces have been stopped in the Tipton, Tividale, and Bilston districts during the quarter, owing to heavy stocks and dear coal.

Altogether five Staffordshire furnaces have been blown out, and in the Midland districts of Derbyshire, Northampton, Leicestershire, &c., it is estimated that since the fall in prices commenced, as many as twenty furnaces have been brought to a stand. At present the accumulated stock of pig iron in the forge yards of the Midlands is believed to be small, but still manufacturers of finished iron buy only small quantities to meet their immediate needs. There is a reluctance to give out even these orders, and smelters have to make concessions to secure them. Fortunately, there is an improved demand for foundry qualities of pig iron, but even in this department buyers are reluctant to place

next year's contracts without some inducement in the shape of lower prices. Prospects, generally, are therefore far from encouraging. Current prices are valued on the open market as:—Staffordshire cinder forge, 57s. 6d. to 60s.; part-mine, 60s. to 65s.; all-mine, 62s. 6d. to 75s.; best ditto, 90s. to 95s.; foundry ditto, 100s.; cold-blast, 120s.; Northamptonshire and Leicestershire, 57s. 6d. to 60s.; Derbyshire, 58s. 6d. to 61s.; and North Staffordshire, 60s. to 62s. 6d.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The downward movement in the iron and steel trades has not yet been brought to a check; the large drop in prices last week has been followed by a further and equally serious fall this week, and there is still no confidence that the lowest point has been touched. Various surmises are being put forward as to a solution of the present situation, and foreign competition is held largely responsible for the collapse of English makers and manufacturers. There is no question that the undue forcing up of prices during the early portion of the year not only put a restriction upon operations requiring any large weight of material, but opened the door to foreign competition both in pig and finished iron, which it will now be found very difficult to close. During the last few months a large weight of both raw and manufactured material has been coming in from abroad into this district, and for the matter of that into practically every other important iron-using centre, and at much lower prices than English manufacturers have been prepared to accept, and it cannot be said, sweeping as have been the reductions in English prices, that foreign competition has even yet been met in a really effective manner.

Such slackness as there is in the engineering trades, to which I have referred in previous reports, and which is more an indication of lessening activity in the future than of any general quietening down just at present, has so far had no appreciable effect upon the employment returns of the trade union societies. The United Machine Workers' Association, it is true, report an increase in the out-of-work list for this immediate district, which is now 2½ per cent., but the returns generally still show only about 1⅜ per cent. of the membership on unemployed benefit, whilst the Steam Engine Makers' Society has still only about ½ per cent. of total membership on donation, and practically a clear book locally.

The Manchester iron market on Tuesday was so altogether unsettled by the continued and serious fall in prices that very little business was practicable, as there is still an uncertainty as to whether the lowest point has yet been reached. The further downward move has been mainly in raw material, and in pig iron buying for the most part was restricted to the smallest possible parcels. Following the considerable drop last week in Middlesbrough iron, it was generally anticipated there would be a further giving way in Lincolnshire pig iron, but the reduction of 4s. per ton on No. 3 foundry, decided upon at a meeting of the makers held on Friday, came rather as a surprise. Delivered Manchester, makers' basis quotations for No. 3 foundry Lincolnshire are now 60s. 6d. net, but merchants are still prepared to book forward at under makers' prices. Lancashire makers have not seen their way to officially reduce their quoted basis, which remains nominally at about 72s. 6d., less 2½, delivered Manchester, but this figure is quite out of the market. Forge Lincolnshire has been reduced 1s. 6d. per ton, and is now quoted 60s. 2d. net delivered Warrington, with Derbyshire obtainable at about 60s. net, and Lancashire quoted about 62s., less 2½. A fairly large sale of American forge pig iron has been made for delivery Warrington, at about 60s. net, but this iron, it may be mentioned, is largely used in the place of hematite. For Middlesbrough foundry prices have again receded considerably, and there are extremely low forward quotations. For prompt delivery good foundry brands could be bought without difficulty at 65s. 10d. net by rail Manchester, with merchants in some instances sellers at 6d. less. Scotch iron is also easier, and is being offered at 71s. to 71s. 6d. net, delivered Manchester docks. There have been tolerably large arrivals of American iron during the last week or two, probably amounting to 20,000 tons, at Liverpool and Manchester. Quotations are, however, being well maintained, 63s. 6d. net, Manchester docks, being an average figure for foundry qualities, although some merchants, it is stated, are offering to book at 62s. 6d. net.

There is practically no change to note in the position of the finished iron trade. Meetings of both the Bar and Hoop Makers' Associations were held in Manchester on Tuesday, but no alteration was made in list basis rates, manufacturers declaring that prices have now got down to a point at which they are below the cost of production, and that consequently there is no margin for further concessions, which in the present state of the market would probably fail to bring forward any appreciably increased buying. Delivered Manchester district, makers' basis quotations remain at £8 for Lancashire, and £8 to £8 5s. for North Staffordshire bars; sheets about £9 2s. 6d. to £9 5s.; and list rates for hoops, £9 2s. 6d. for random to £9 7s. 6d. for special cut lengths delivered here, and 2s. 6d. less for shipment. Here and there some increased buying is reported by makers, but generally the new business that is being booked is still extremely small, and forges are very indifferently engaged, whilst merchants in the open market continue to undersell.

An extremely depressed and unsettled tone prevails in the steel trade. In hematite the continued downward move has brought about so much irregularity in prices that only approximate figures are obtainable, ranging from about 78s. to 80s. and 82s., less 2½, for No. 3 foundry, delivered Manchester, but these figures can scarcely be taken as representing actual business. Local billets are not now quoted more than £5 10s. net. There are reports that steel bars are to be bought as low as £7, and there are free sellers at £7 10s., with makers' quotations ranging from this figure upwards. The anticipations of lower prices for steel boiler plates have been fully realised, the makers' association having been temporarily suspended, so that the associated members might be at liberty to quote under the nominal official list basis of £9, less 2½. The result has been that boiler plates have been offered freely during the past week at £8 10s., delivered here; but even this figure is not binding on makers, and lower prices are spoken of, with, however, no business doing to really test the market.

At the annual general meeting of the Manchester Association of Engineers, held on Saturday last, Mr. Henry Hodgson, of Messrs. Scott and Hodgson, Guide Bridge, was re-elected president for the ensuing year. The other offices in connection with the society were filled up as follows:—Treasurer, Mr. James Walthew; trustees, Messrs. G. Carter, T. Ashbury, J. West, S. Dixon, Sir W. H. Bailey; members of committee of management, Messrs. J. Saxon, W. Smith, and J. E. Hardman; auditors, Messrs. G. Fielden and E. G. Constantine; secretary, Mr. Frank Hazelton; librarian, Mr. Robert Gass.

A discussion also took place at the above meeting with reference to the appointment of an expert for the electric traction scheme of the Manchester Corporation. The proceedings of the Corporation Sub-committee who have the matter in hand have evidently given rise to a fear lest someone should be appointed as expert who would not sufficiently consider the interests of British engineers in any recommendations he might make, and the question has been under discussion in the columns of the daily press. The matter was brought up at the meeting on Saturday by Mr. Joseph Nasmith, who proposed a resolution to the effect, that in the opinion of the meeting it was desirable, in the interests of the British engineering industry, that the Manchester City Council appoint, as expert for the electric traction scheme, a capable British engineer. This proposal was seconded by Mr. James Saxon, a former member of the Electricity Committee of the Manchester Corporation, and unanimously adopted.

There are no complaints from colliery owners as to the position of their branch of trade. All descriptions of fuel are reported to be in steady demand, and with collieries able to move off their output—in some instances filling up out of stocks—no difficulty is experienced in maintaining prices. In fact, in some directions, particularly as regards the best qualities of slack, prices, if anything, are stronger, although in the lower descriptions a considerable surplus is still offering from other districts, and consumers, where the inferior sorts meet their requirements, are able to buy at comparatively low figures. In the better qualities of round coal, although there is still no real pressure for house-fire consumption, the demand is increasing, and prices are very firm at the full list rates. The lower qualities of round coal are also now being rather more drawn upon for common house-fire consumption, but the demand for steam and forge purposes is beginning to show some falling off, which is perhaps only what might be expected, considering the very general depression that has recently come over the iron trade of the district. For the present, however, the lessened inquiry for forge coals does not make itself appreciably felt, and prices are steady at the recent quotations, averaging about 12s. 6d. to 13s. for ordinary qualities at the pit. A good deal of extra buying is just now going on in engine fuel, as is usual at this time of the year, when consumers are generally preparing to cover requirements over the holidays, but the large contracts for forward delivery are still for the most part in abeyance. For some of the special qualities of slack, supplies of which are not at all plentiful in Lancashire, most of the collieries being rather short if anything, 11s. to 11s. 6d. is being quoted, with the good medium sorts averaging about 10s. 6d. at the pit. For inferior sorts of slack, however, prices are irregular, and from Derbyshire, Staffordshire, and Yorkshire, there are cheap parcels to be picked up at considerably below the quotations that are current at Lancashire collieries.

The shipping demand continues only moderate, and common coals are to be bought at low figures, but for ordinary descriptions of steam coal 15s. 3d. to 15s. 6d. remain about the average quoted prices for delivery at the ports on the Mersey.

Makers still report a fairly active inquiry for the best foundry cokes, and they are maintaining their prices at about 28s. to 30s. at the ovens. With, however, the increasing depression in the iron trade, furnace cokes are becoming more difficult to move, and the tendency is towards a steady easing down in quotations, although 14s. to 15s. at the ovens still represent about the minimum actual quoted rates.

Barrow.—There is a weaker tone in the hematite pig iron trade this week, and orders are not coming in as freely as they did some time ago. For some weeks past bearing operations have been bringing down the values of warrant iron in consequence of the lessened demand for metal, and notwithstanding the fact that stocks have been very considerably reduced, prices went down as low as 66s. 7½d. net cash sellers, but they have since improved to 68s., buyers 67s. 9d. This advance doubtless results from the fact that while stocks of iron increased last week by over 700 tons, they have been reduced this week by 3108 tons, and now stand at 23,863 tons, being a reduction of 173,984 tons during the year. Makers of iron have also reduced their quotations to 70s., 72s. 6d. net f.o.b. for mixed Bessemer numbers. They threaten to blow out some of the furnaces they have in blast rather than follow the slump in prices caused by bearing operations. There are only thirty-seven furnaces in blast, two of which are employed on spiegeleisen, as compared with forty-seven furnaces in the corresponding week of last year.

Iron ore is in active demand, and orders are as briskly maintained as before the shrinkage in the production of pig iron. Prices are very firmly maintained at 17s. for good average sorts net at mines. Spanish sorts are at 18s., and are in large delivery to West Coast smelters.

The steel trade is fairly well employed, but there is a scarcity of orders for heavy steel rails, ship plates, and the principal products of the district. There is, however, a good trade in hoops, billets, and general merchant descriptions of steel.

Shipbuilders and marine engineers are very busy, but are now in a position to accept new orders, and these are expected as well in the mercantile marine as from Admiralty sources.

The coal and coke trades are again easier in tone, and a general tendency towards lower prices is being shown.

The export shipping trade is moderately employed. During the past week the shipments of iron have been 3620 tons, and steel 10,956 tons, as compared with 23,331 tons of iron and 12,849 tons of steel in the corresponding week of last year, a decline in iron of 14,711, and in steel a decline of 1893 tons. The shipments this year represent 598,844 tons of iron, and 389,905 tons of steel, as compared with 513,287 tons of iron and 465,779 tons of steel in the corresponding period of last year, an increase in iron of 85,557 tons, and in steel a decrease of 75,874 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE Yorkshire and Derbyshire coalowners are at last wakening up to the fact that business is steadily trending downwards. Pits are now working shorter time than they have done at any previous period this year. Although the output is being practically restricted by many of the pits "playing" two days per week, this does not prevent a significant increase of stocks at the collieries, and the business which is done is confined almost exclusively to deliveries under existing contracts. At the same time there is no distinct drop in values, as sales are not pressed; but to effect transactions on any scale at the present moment, coalowners would have to accept reduced prices. Buyers are not at all eager, as they look for further concessions before long.

In house coal there is very little doing, consumers having generally laid in stocks during the panic period, a month or six weeks ago, and unless hard weather comes quickly, it is impossible to avoid a fall in values. The London trade is keeping quiet, while the demand from the Eastern Counties, as well as for local districts, is very slender. At the same time, merchants have no stocks in hand, and should frost and snow arrive, they would be soon requiring supplies from the pits. Purchasers, however, confidently expect a fall in prices, and this view appears to be general. In any transactions of importance the figures have favoured the buyer, although public quotations keep at last week's prices:—Best Silkstones, 15s. to 16s. per ton; Barnsley house, 14s. to 15s. per ton.

The railway companies do not seem disposed to accept a reduction of 1s. a ton which the coalowners are offering. It is contended that 15s. a ton for locomotive fuel will still leave the railway companies to pay 4s. per ton more than they paid fifteen months ago, and the railway managers are standing out for a reduction of 2s. or 2s. 6d. The steam coal trade, of course, is affected by the closing of the Baltic ports, while there has been considerably less doing in the inland trade, owing to the shrinkage in the iron districts. There is not likely to be much done on forward account until the present uncertainty is removed by a settlement of the railway contracts. Once a price is fixed for railway companies, a standard will be established by which other trades will be regulated. At present quotations are maintained at 15s. to 16s. per ton for Barnsley hards; but business has been and is being done at irregular values.

Gas coal is now being pressed for, and the companies are stocking heavily; in fact, they would take more if they could get it, gas coal occupying a unique position in the fact that there is more demand than can be met. The revival in the Lancashire mills has caused engine fuel to be firmer; still the output is more than equal to requirements, and values remain unaltered:—Nuts, 9s. 6d. to 10s. 6d. per ton; screened slack, from 7s. 6d.; pit slack, from 6s. per ton.

The coke trade does not improve. Steel manufacturers are pressing coke makers for easier terms, and are looking forward for a reduction of 2s. to 2s. 6d. per ton in the charges for steel-melting coke. Both coalowners and coke makers are handicapped by the fact that wages of colliers will go up 10 per cent. in January next. This is a serious consideration for the coke makers, as it means 20 per cent. increase, the production of one ton of coke requiring two tons of coal.

The Yorkshire coal trade with Hull for November shows a total weight of 385,600 tons, as compared with 293,792 tons for the corresponding month of last year. The weight for the completed eleven months of the year is 3,864,960 tons, against 3,248,160 tons for the corresponding period of 1899. Denaby and Cadeby Main continue to head the list, although their tonnage last month, 32,768 tons, is considerably less than for the corresponding month of 1899, when the weight was 44,192 tons. For the eleven months of the year, however, the weight is 501,584 tons, against 401,064 tons for the eleven months of 1899. The foreign trade again shows a large increase, the weight of coal exported in November from Hull having been 162,171 tons, while the weight for November of 1899 was 126,963 tons. For the eleven months of this year the weight was 1,918,993 tons, against 1,685,170 tons for the eleven months of 1899. France shows by far the greatest increase, 22,871 tons, last month, as compared with 5434 tons in November of 1899; for the eleven months, 129,001 tons, against 55,374 tons. Germany took last month 21,483 tons, against 16,690 tons in November of 1899; for the eleven months, 233,534 tons, against 187,631 tons. Denmark has also largely increased its requirements, from 3589 tons in November of last year to 8252 tons last month; the eleven months show an advance from 47,850 tons to 100,951 tons. Russia, north and south, exhibits a great falling off on the month, as well as on the eleven months. Sweden, on the other hand, has increased from 29,220 tons in November of 1899 to 49,391 tons last month; for the eleven months, however, there is a decrease, the weight from January to November this year being 422,063 tons, against 459,312 tons during the corresponding period of last year. Other increasing markets are Belgium, Holland, Italy, and Turkey. The exports to Egypt are considerably lighter.

In the heavy trades there is still abundant business in the manufacture of war material, the demand, indeed, being equal to occupying all the plant at present available. Nor is there likely to be any change for a considerable time. Heavy orders for shot and shell and similar work are constantly being received, while the armour plate mills are running night and day. In spite of the improvement in northern shipbuilding yards, more work could be done in marine material. A similar remark applies to railway material. The railway companies are hampered by dear coal and advances in stores of every description. The increased expenditure thus entailed has caused them to be careful in restricting their orders to immediate requirements. Crucible steel manufacturers find their work very inadequate for their plant. With the exception of several houses which have large foreign connections to depend upon, full time is not being worked in the other establishments. Makers of Bessemer and Siemens steel are much better off than firms engaged in crucible qualities. The "slump" in the steel trade which was anticipated a few months ago is now fully evident, particularly in the case of the smaller firms.

Foreign trade in cutlery during November last amounted to £59,399, being £265 less than that of the corresponding month of last year. All markets show a decrease except Germany, Chili, British Possessions in South Africa, and Australasia. The trade with the United States, however, dropped away by about one-half, and heavy decreases were also shown by Germany, Holland, France, Spain and Canaries, Foreign West Indies.

In unwrought steel there was exported during November the value of £233,376, as compared with £318,453 for November of 1899. This decline in business was anticipated, as a shrinkage in the foreign demand in steel has been perceptible for several months. It is interesting to note that the principal decreasing market has been Germany.

NORTH OF ENGLAND.

(From our own Correspondent.)

SELLERS of iron and steel are finding their way more difficult than it has been for years; competition has become very keen amongst them, prices decline, orders are not readily obtainable, and it is getting to be a rather hard task with some manufacturers to make ends meet. This month has been as remarkable for receding prices as the spring months were for advancing rates. Then the value of iron and steel reached figures that have never been known to the majority of producers now engaged in trade, for they were above anything reported for the last twenty-five years. Now they have receded until they have got back to the figures ruling a year and a-half ago. No legitimate buyers will operate while almost every day shows some falling off from its immediate predecessor, and the disorganisation of business becomes rapidly worse. As compared with the best prices of the year and of the last twenty-five years, the rates which as regards pig iron were ruling so recently as April last, and as regards manufactured and steel no longer ago than July, have declined substantially; in fact, Cleveland No. 3 pig iron has gone down 21s.; East Coast hematite, 14s. 6d.; iron bars, 30s.; steel plates, 32s. 6d.; iron plates, 37s. 6d.; and steel rails, 35s. Large as these reductions are, there is reason to believe that they will continue, for the next three months is the worst part of the year, and a time when traders cannot well expect to see improving prices, more especially when almost everything seems to be against them. The various concomitants of declining trade are now beginning to be generally reported—decreasing shipments, increasing stocks, furnaces going out, irregular working of finished iron and steel manufactories, and hands being discharged because of lack of work for them. But as yet there have been no reductions in wages, these continuing at the highest rates that have been paid since 1874, but the sliding scales will in all probability early in the new year give the employers some relief in this respect.

The export pig iron trade in this district this month is undoubtedly most unsatisfactory; in fact, the shipments from Cleveland are smaller than they have been in any month since the early part of 1895, and do not promise to exceed 50,000 tons, whereas the average of this year has been over 97,000 tons per month, and last year it was 114,000 tons. Up to Wednesday night the exports reached 21,064 tons, as compared with 31,436 tons last month, and 41,700 tons in December, 1899, to the 12th. The falling off in the oversea trade has been remarkable this month. Home demands have likewise been poor, and under the circumstances it is not surprising that stocks are accumulating at a considerable rate, certainly in the public warrant stores, and it is believed also in makers' hands, but as to the latter there are no statistics available, for since September, 1896, they have issued no returns. In Connal's public warrant stores the stock of Cleveland pig iron is increasing at the rate of over 600 tons per working day, which means that what is equal to the entire output of seven of the sixty-six furnaces now at work in the Middlesbrough district is going into Connal's stores alone. In addition to this a considerable quantity of Cleveland iron is being sent into the North-Eastern Railway Company's warrant store—nearly 4000 tons went in last month. It is evident that there is a good deal more iron produced than is now required. Up to September 4th the stock of Cleveland iron held by Messrs. Connal and Co. was declining until only 10,463 tons were held, the smallest quantity ever reported by Messrs. Connal and Co. since they took over the stores on Tees-side in 1876. Since September 4th there has been an increase of 19,894 tons.

The demand for Cleveland pig iron has not been slacker at any time since 1895 than it is this month, and from the increase of stock it is evident that more furnaces should be blown out than as yet are contemplated—only three. Consumers have no difficulty in getting all the iron they require, even for very prompt delivery;

in fact, they can get delivery in a day or two of any iron they buy. There is no shortness in the supplies of pig iron as there was in the spring and summer; on the contrary, there is a plethora, and producers are pressing sales. The prices have now declined to figures which will not cover the cost of production at a number of the works. As yet the only relief that producers of ordinary Cleveland iron have had to counterbalance their reduction of 21s. per ton in the selling price has been a decrease of 12s. in the price of coke. Hematite pig iron makers, in addition, have had Rubio ore reduced 4s. 3d. per ton, but wages are as high as ever they have been. They will drop, however, according to the sliding scale. No. 3 Cleveland G.M.B. pig iron for early f.o.b. delivery has been brought down to 57s. 6d. per ton this week, or 3s. less than the rate ruling last week. The lower qualities have not fallen quite so quickly as No. 3, but still they are yet relatively lower. For No. 4 foundry 56s. 6d. has been paid; for grey forge, 56s.; mottled, 55s. 6d.; and white, 55s., all for early delivery.

The value of East Coast hematite pig iron has been further reduced, and while most makers have lowered their price of mixed numbers to 74s. per ton, they have been accepting 73s., or 3s. less than the figure at which they were doing business last week. Rubio ore has been sold for delivery at makers' wharves in the district at 17s. 6d. per ton, but 18s. is the general quotation.

The demand for manufactured iron and steel is quiet, and further reductions in the prices of plates and angles have been made, but without stimulating buying. Iron ship plates have gone down 7s. 6d., and steel ship plates and angles 5s. Iron ship plates can now be bought at £6 12s. 6d., steel ship plates at £6 15s., and iron and steel ship angles at £6 15s., all less 2½ per cent. f.o.t. Common iron bars are at £8, less 2½ per cent. f.o.t. Heavy steel rails can readily be bought at £6 net at works. A rumour has been in circulation that the North-Eastern Steel Works, Middlesbrough, were to be closed. This is not the case; indeed, they are erecting a new mill. The only stoppage will be the usual one for the holidays, when stock-taking will be proceeded with. The Chancery Court has granted the Consett Iron Company the extended powers they asked for to enable them to become shipowners, railway proprietors, farmers, &c. It was shown that becoming farmers was desirable, because the company owned considerable tracts of land under which were minerals, and it was cheaper to own and farm the surface than to pay damages for subsidences. It was stated that the capital of the company was £1,500,000, and that it had no debenture debt, while its reserve fund amounted to £250,000.

William Whitwell and Co., Limited, Thornaby Ironworks, Thornaby-on-Tees, has appointed as its mill manager, in place of the late Mr. Edward Fletcher, Mr. J. Perry, who has been at the Patent Shaft and Axle-tree Company's works, Wednesbury. Echalaz, Leith, and Co., iron and steel merchants, Neville-street, Newcastle-on-Tyne, have taken into partnership Mr. C. F. H. Bolckow, Middlesbrough, and the style of the firm in future will be Leith, Bolckow, and Co. In consequence of the death of Mr. Charles Jesper, the directors of the North-Eastern Railway Company have made a re-arrangement of offices. Mr. Philip Burtt, now superintendent of the line, is appointed to a new post at the head of all traffic departments, as general traffic manager. Mr. James Forsyth, now district passenger superintendent at Newcastle, is appointed assistant traffic manager. Mr. W. Robinson, now head of the Rates and Fares Department, is to be chief goods manager, and Mr. H. A. Watson, now assistant superintendent, is to be superintendent of the line.

The demand for new shipping is somewhat more favourable, builders, on account of the reduction in the cost of materials, having been enabled to quote prices which have made owners more disposed to buy, and inquiries are fairly numerous. The orders already booked will keep most of the yards well occupied during at least the first half of next year, and some during the whole year.

The coal market is showing improvement on what has been reported for some weeks past; the downward movement, at any rate, is checked, inquiry is brisker, especially for steam coals, and shipments are on a larger scale than for several weeks. Collieries are working more fully as a rule. The price of best steam coals has improved, 14s. 9d. to 15s. f.o.b. being quoted for best, and 8s. for smalls. The tenders sent in for the North-Eastern Railway Company's contract for next half-year are said to be on the average at 2s. per ton above the figures quoted at this time last year. Best gas coals are sold at 13s. 6d. f.o.b., and bunkers are at 12s. to 12s. 6d. f.o.b. Coke is weak; in fact, there have been sales of medium qualities at as low a figure as 17s. 6d. per ton at Middlesbrough furnaces, and almost any seller will take 18s. to 19s. A dispute has occurred at Tyne Dock which will seriously interfere with the coal shipping traffic. About 160 mineral guards have come out on strike, because of a new arrangement as to the employment of vans. Hitherto each guard has had his own particular van, but it was announced that in future a guard must take the first van available. The men object to this. But the company's officials state that the old arrangement was the cause of much inconvenience, expense, and delay, as often a van had to be brought for miles to be attached to a train. The men's argument is that if they have to take any van they will be deprived of the comforts which they provide for their journeys in their own particular vans. It is expected that the guards at some of the other North-Eastern ports will come out in support of the Tyne Dock guards, and the engine drivers are urged to refuse to go with incompetent guards.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market has been unsettled and prices irregular after the heavy fall in values that occurred last week. For some time previously rates had been maintained in the belief that there was a "bear" account open, and that purchases would require to be made to cover the operations in connection with it. But when certain holders of warrants found it expedient to sell towards the end of last week, it was suddenly discovered that there were practically no buyers in the market, and so prices of Scotch warrants suddenly fell to the extent of 5s. per ton. Following upon this sudden collapse, some of the makers reduced the prices of special brands as much as 2s. 6d. to 3s. per ton.

The pig iron market opened this week very flat, and business was done in Scotch warrants from 62s. 6d. to 59s. 8d. cash, and 61s. 6d. to 60s. 7½d. one month. There has subsequently been a partial recovery on purchases of iron being made, but the tone continues very unsettled, and there is not likely to be much business done this side of the holidays. Cumberland hematite warrants have been bought from 66s. 7½d. to 66s. 8d. cash and 67s. 6d. one month. A quantity of Cleveland warrants changed hands at 55s. 9d. one month. Brokers state that consumers are not purchasing at all freely, and that the business now doing is mainly of a speculative nature, induced by the violent fluctuations in prices.

There are now 82 furnaces in blast in Scotland, compared with 81 in the preceding week and 83 in the corresponding week of last year. Of these 41 are producing hematite, 36 ordinary, and 5 basic iron.

Scotch hematite pig iron is quoted by merchants 80s. per ton for delivery in railway trucks at the steel works.

The prices of Scotch makers' pigs are all reduced as follows:—Govan, f.o.b. at Glasgow, No. 1, 64s.; No. 3, 63s. 6d.; Carnbroe, No. 1, 67s. 6d.; No. 3, 66s.; Clyde, No. 1, 77s.; No. 3, 67s.; Gartsherrie and Calder, Nos. 1, 78s.; Nos. 3, 68s.; Summerlee, No. 1, 82s.; No. 3, 68s.; Coltness, No. 1, 84s. 6d.; No. 3, 68s.; Glengarnock, at Ardrossan, No. 1, 78s.; No. 3, 67s. 6d.; Eglinton, at Ardrossan or Troon, and Dalmellington at Ayr, Nos. 1, 68s. 6d.; Nos. 3, 67s.; Shotts, at Leith, No. 1, 81s.; No. 3, 69s.; Carron, at Grangemouth, No. 1, 78s.; No. 3, 68s. per ton.

The shipments of pig iron from Scottish ports in the past week were 5581 tons, compared with 6774 in the corresponding week of last year. There was despatched to South America 100 tons; India, 30; Australia, 175; France, 130; Italy, 70; Germany, 186; Holland, 675; Belgium, 150; Spain and Portugal, 126; China and Japan, 450; other countries, 220; the coastwise shipments being 3269, against 3512 in the same week of last year.

At most of the steel works there is a good measure of employment, but the future is somewhat uncertain. The important element of foreign competition has to be reckoned with. Not only is material likely to be available from America, but it is thought that continental makers will henceforth seek a more regular outlet for their manufactures here. The want of a proper understanding with Lloyd's as to the testing of American material for shipbuilding purposes appears to have warded off for the time the pressure of American competition in that particular department. It may be taken for granted, however, that arrangements will be made as soon as possible, so that Lloyd's inspectors will be available to superintend the tests at the principal United States steel works. Of course, there will always be the difficulty of freight, and now that prices of raw material are going back at home, our makers may be expected to be in a position in which they will be more likely to be able to hold their own with the foreign manufacturer.

In the malleable iron trade there is a want of activity. Short time has to be resorted to at a number of the works, and notwithstanding the substantial reduction that was recently made in prices, new orders are not easy to obtain.

The engineering trades are for the most part well employed. Locomotive engineers are not only fully engaged, but in some cases the necessity for pushing contracts forward with all possible celerity has rendered necessary the working of overtime. Bridge work is in good demand, and a great deal of it is in course of execution. General engineers have also a large amount of miscellaneous work in course of execution, and founders have so far been busy, with some exceptions, the latter more particularly in connection with household castings.

The coal trade is well employed, although there can be no doubt that the decline in prices will continue. Shipments compare well with those of the preceding week, but the current demand for export is in a backward state, a number of the foreign markets being glutted with coal, and it being impossible for shippers to obtain anything like the prices recently paid. The decline in freights has no doubt been considerable, but even when full allowance is made for this, it is very difficult to arrange fresh business. The prices at Glasgow harbour are, for main coal, 11s. 6d. to 12s.; steam and ell, 13s. to 13s. 6d.; splint, 13s. 6d. to 14s. 6d. per ton. The domestic consumer is being charged high rates—higher in proportion than the shipper—this being accounted for by the desire of the coalmasters to keep hold, if possible, of the shipping trade.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

IT was stated, authoritatively, at the docks, Cardiff, on Saturday that many buyers who had been keeping off the market until the last moment were getting nervous as to securing the supplies which they require for delivery this side of Christmas, and the result was an increased firmness in prices. Best steam coals are reported firmer, and a strong demand is setting in for good ordinaries, best Monmouthshire, and for loading drys. Small steam are not expected to improve materially until after the holidays, but the outlook is better, and also for house coals, which only await harder weather to advance. Foreign depôts are said to be fairly well stocked, and the reduction of prices of coal in France may slightly affect the export to that country. Last week it was reported that the ending of the strike at St. Nazaire had a perceptible influence on shipments to France. The week ended with the despatch from Cardiff alone of twelve cargoes, December 7th, three of which went to St. Nazaire. Genoa on that day continued its activity, importing three cargoes from Cardiff, one of 4000 tons. An item favourable to the Welsh coal trade is to be found in a Russian Government contract placed in Cardiff for 140,000 tons. Flack, Tanner, and Co. secured 60,000 tons; Powley, Thomas, and Co., 40,000; and Morgan and Walkley, 40,000 tons. Prices are understood to range from 28s. 3d. to 28s. 6d. These figures include charter, insurance, and freight. Delivery to extend from January to June.

A subject of comment in trading circles is the increased attention paid by foreign capitalists to Welsh industries. Three relays of Spaniards are now settled down in steel works districts, a large contingent of Italians engaged near Llanidloes, in the silver lead mines, and now certain capitalists of Belgium have secured a large tract of coal in the neighbourhood of Llanelly. This is the Great Morfa of 1000 acres. The capital invested is stated to be £120,000. The Belgian projectors' own steel works, with a capital of £500,000, and it is rumoured that it is in contemplation to run a fleet of steamers from the Welsh port to Belgium. I hear that Mr. Lenge, mechanical and mining engineer, is the representative of the syndicate at Llanelly. Local comment is that though the acreage of steam coal in Wales is yet large, the time will come when the anthracite resources from Swansea to St. Bride's Bay will be called upon, and that this is a "bid in advance."

In this column I have several times suggested caution to the pessimists who hint at coming scarcity. Plymouth collieries, which have been worked freely and ably, are reported good for 120 years even at present pressure, and the Powell Duffryn Collieries, which in 1879 were confined to 5000 acres, now possess 10,000 acres, computed by Mr. Hann, one of the first rank of mining engineers, to represent 160 million tons. The evidence of Forster, Brown, and Galloway respecting other fields is equally encouraging. The new colliery, the Windsor, in which they are interested, has had a run several times this week for its preferential scrip at ½ premium.

The latest coal prices, Cardiff, this week are as follows:—Best large steam, 19s. to 20s.; seconds, 17s. to 18s.; drys, 16s. 9d. to 17s. 6d.; best steam smalls, 10s. to 10s. 6d.; good seconds, 9s. to 9s. 3d.; dry and inferior sorts from 8s.; best Monmouthshire large, 17s. 3d. to 17s. 6d.; seconds, 15s. 6d. to 16s. 6d.; best house coal, 20s. to 21s.; seconds, 17s. to 18s.; No. 3 Rhondda, 17s. 6d. to 18s. 6d.; brush, 15s. 6d. to 16s.; small, 12s. to 13s.; No. 2 Rhondda, 15s. 6d. to 15s. 9d.; through and through, 13s. to 14s.; small, 8s. to 8s. 6d.

Mid-week, on Change, Cardiff, increased firmness was shown in best steam, and house coals were in improved demand; small steam easy. Colliery shares continue to fluctuate, and those whose opinion of the coal trade is governed by the share market have not an easy problem. A point up one day and down another is common. Mid-week Davis's Ferndale dropped ½, Ebbw Vale ½, Great Western ⅛, International ⅛, and North's again were reported ⅛ firmer.

Newport, Mon., coal trade continues satisfactory, and large shipments are taking place. One day last week ten important exports were made, Buenos Ayres taking 2250 tons, a second of 2940, and Genoa 3400, and others of note.

Swansea total was a little below late averages, the incessant bad weather delaying tonnage.

The coal returns of shipments from Wales during 1900 will exceed 20,000,000 tons. November total from Cardiff was 1,340,152 tons, a fair increase over November, 1899, total. Newport, Mon., despatched last month 306,369 tons, Swansea 208,332 tons, Llanelly 21,197 tons, and Port Talbot 25,577 tons. During the year, so far, Cardiff has despatched 30,713 tons of iron and steel, 68,836 tons coke, and 378,744 tons patent fuel. Newport, Mon., 14,541 tons iron and steel, 28,697 tons coke, and 68,067 tons patent fuel. Swansea 2276 tons iron, 11,590 tons coke, and 463,073 tons patent fuel.

Swansea coal prices this week are as follows:—Anthracite first-hand picked, 24s. to 25s.; seconds, 20s. to 21s.; best large, 18s. to 19s.; red vein or similar large, 15s.; rubbly culm, 8s. to 8s. 6d.; steam, 16s. to 20s.; bunkers, 13s. to 14s.; small, 7s. to 8s. 6d. House coals: No. 2 Rhondda, 16s. to 16s. 6d.; through, 13s. to 13s. 6d.

Patent fuel, 18s. to 18s. 6d.; Cardiff prices, 19s. to 22s. Coke: Swansea, best foundry, 32s. to 34s. Furnace coke, Cardiff, has declined to 24s. 6d. to 27s., but at last date a better inquiry was reported; foundry is selling at 27s. to 30s., and special 31s. to 36s.

Pitwood, Cardiff, is at 18s.; Swansea prices, 19s. to 19s. 6d.

Considerable interest has been aroused in the Cardiff district by the announcement that, on and from the 1st of January, Sir W. T. Lewis, Bart., who has for twenty years been general manager of the Bute Dock, Cardiff, will retire from that position, and enter upon the more important post of managing director of the Cardiff Railway Company.

Mr. Ellis has been appointed chief electrical engineer Cardiff, salary £750, rising to £1000. To hold for five years, and not to apply for other positions. There has been an increased import of pig iron this week to Welsh ports, principally from Millom, Whitehaven, and Barrow, and one cargo of rails, 250 tons, from Southampton to Newport. A fair quantity of ore has come in from Spain, and one cargo, 2100 tons, manganiferous ore from Carthagena for Pyle and Blaina.

Steel tin-plate bars continue to arrive from America. Swansea this week received 350 tons. In November the total received was 10,603 tons, making for the year close upon 20,000 tons. Some of the Swansea Valley works are now using exclusively the American bars. One buyer states that, as regards quality, though not equal to the Welsh, it suits oil plates. The lessened prices for Welsh may be expected to block new contracts. Those placed must, however, run out.

On 'Change, Swansea, the running down in the prices of pig iron was the subject of comment, and speculation as to the extent was general. During the week the drop has been 7s. in Scotch and 7s. 4d. in hematite. Middlesbrough is lower, but no quotations appear this week. The fall in pig is ascribed to the American competition. A downward course in finished iron and steel has begun, though in some branches a moderate degree of activity is exhibited. At Dowlais the bar mill is idle, but the other mills in the old works are running as usual. In the ironwork the make of finished goods was fair, and mills and shops fully employed.

In the Swansea Valley the steel trade is in a depressed condition, two furnaces less smelting than in the preceding week. At Cwmfelin the whole of the steel and bar rolling departments are idle. There, and at Cwmbwrla, American bars are now used. These are also being used at Morriston Works, Tyrcanol, and at Foxhole. In the tin-plate trade the proposal of employers for an average make of 640 boxes per mill per week is looked upon by tin-platers with favour. Prospects are decidedly improving with the falling prices of raw materials, yet manufacturers say that the trade is still critical. Block tin is lower again. Quotations generally are as follows, but some must be taken as nominal:—Glasgow pig iron warrants, 60s. 4d., 60s. 8d., 61s. cash; hematite warrants, 67s. 4½d. to 67s. 4d., for mixed numbers. Welsh bars, £8 to £8 5s.; sheet iron, £8 7s. 6d. to £8 10s.; steel sheets, £8 5s. to £8 7s. 6d. Steel rails, heavy, £6 to £6 5s.; light, £7 10s. to £7 15s. Bessemer steel tin-plate bars, £5 5s.; Siemens, £5 7s. 6d. Tin plates: Bessemer steel cokes, 13s. 4d. to 13s. 6d.; Siemens, 13s. 6d. to 13s. 9d.; ternes, 26s. to 29s.; best charcoal, 15s. to 16s. Big sheets for galvanising, 6ft. by 3ft. by 30 g., per ton, f.o.t., £10 15s. to £11. Block tin, £122 2s. 6d. to £122. Lead, £16 12s. 6d. Spelter, £18 17s. 6d. Copper, Chili bars, £71 10s. to £72 6s. 3d. Iron ore:—Tafna, 17s. 6d.; Rubio, 18s.

Last week tin-plate shipments totalled 49,751 boxes; received from works 60,922 boxes, leaving stocks at 156,533 boxes. A good total is expected this week of exports; large loadings getting ready for Russia, China, Japan, and New York. During November the export was 15,223 tons, as compared with 17,927 tons for the corresponding month.

St. David's Gold and Copper Mines continue to show good results. Twenty additional stamps have been put in. Last month 1940 tons were milled; bullion recovered, 1350 g.

At an appeal before the Assessment Committee, Merthyr Guardians, on Saturday, Mr. Yeasley, Taff Vale Railway, stated that the line in the Aberdare Valley did not pay. This is owing to the fact that the promoters of this branch—Sir John Guest and Mr. Crawshay Bailey—received 10 per cent. from the Taff Vale Railway when the latter purchased the line, and this by terms of purchase continues to be paid to heirs and assigns.

Sir John Jones Jenkins has opposed the eastern site Swansea Dock extension, and suggested the Mumbles. Strong opposition, but it is hoped not successful, is being brought to bear against the Bristol Dock scheme.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal market is firmer, and a fair supply of tonnage. House coal unaltered, there being still a want of coasting vessels. Exports for week ending December 7th were:—Coal, foreign, 57,804 tons; coastwise, 16,195 tons. Imports for week ending December 11th were:—Iron ore, 3850 tons; manganese, 5350 tons; pig iron, 2160 tons; old rails, 260 tons; oak logs, 1326 loads; pitwood, 3170 loads.

Coal: Best steam, 17s. 6d.; seconds, 16s. to 16s. 6d.; house coal, best, 19s.; dock screenings, 9s. 6d.; colliery small, 8s. 6d. to 8s. 9d. Pig iron: Scotch warrants, 61s. 9d.; hematite warrants, 68s.; Middlesbrough, No. 3, 56s. f.o.b. Cumberland prompt. Iron ore: Rubio, 17s. 6d. to 18s.; Tafna, 17s. 3d. to 17s. 6d. Steel: Rails, heavy sections, £6 to £6 5s.; light ditto, £7 10s. to £7s. 15s. f.o.b. Bessemer steel tin-plate bars, £5 5s.; Siemens steel tin-plate bars, £5 7s. 6d.; all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 13s. 3d. to 13s. 6d. nominal; Siemens, coke finish, 13s. 6d. to 13s. 9d. nominal. Pitwood: 19s. to 19s. 3d. ex ship. London Exchange Telegram: Copper, £71 10s.; Straits tin, £117. Freights easier.

AN EXHIBITION OF GAS APPLIANCES is to be held at the Royal Aquarium, Westminster, from Friday, December 21st, till Tuesday, January 22nd next. A prominent feature will be the acetylene section, in which it is proposed to demonstrate the great strides this new illuminant has made during the past twelve months. Gold, silver, and bronze medals and diplomas will be given for the most efficient apparatus for the manufacture and distribution of acetylene gas.

GLASGOW UNIVERSITY ENGINEERING SOCIETY.—At the meeting of the Glasgow University Engineering Society on Thursday, Mr. T. A. B. Carver, B.Sc., delivered a lecture on "Engineering Experience in Relation to Research." By means of lantern slides Mr. Carver showed what the Pittsburgh Iron Company had done to mine transport, and convert their iron ores, and how their organisation was all upon thoroughly scientific lines. The lecturer considered the work of noted engineers, and showed the influence of scientific knowledge. On the motion of the chairman, Mr. J. D. Cormack, a vote of thanks was accorded to Mr. Carver. On Saturday, 8th December, the members of the above Society visited the works of the Scottish Co-operative Wholesale Society, Limited, Shieldhall. Arriving at the works about 10 a.m., the party were met and conducted through the various departments by Mr. Coats, the manager, who explained in a very thorough and capable manner the many objects of interest. The printing, cabinet-making, and boot-making sections were specially interesting, the machinery in many cases being novel and very ingenious. At the end of the visit, cakes and tea were served; and, on the motion of Mr. J. M. Clark, a vote of thanks was given to the firm, to which Mr. Coats suitably replied.

NOTES FROM GERMANY.

(From our own Correspondent.)

IN most departments of the iron industry the quietness previously noted has been increasing during the week. Consumers, expecting a further reduction in prices, restrict their purchasing to the utmost, and exports in iron and steel have also fallen off considerably; only from Silesia a fairly good trade was done to Poland, Russia, and Roumania, the number of contracts having increased against previous months, but the condition of prices is very unsatisfactory, and the cause of complaints among producers. Pig iron is very quiet, and demand shows a falling off against last week, while prices, though officially the same as before, are inclined to move downwards if the order in question is of any weight. The contracts received in the manufactured iron department, though small in number, are yet sufficient to keep the mills in fairly good occupation for the present, and a further restriction in output need not, therefore, take place.

Work is difficult to obtain in the bar and girder trade, but the mills engaged in the production of plates, especially the heavier sorts, can be reported to have remained briskly occupied upon the week. There is, likewise, a good deal of activity exhibited in all the railway and engineering trades, but the steel and hardware industry shows symptoms of increasing dulness.

The demand for all classes of engine fuel is much less vigorous than formerly, and the tone of the German coal market is, consequently, less strong. In house coal a brisk trade continues to be done, and very satisfactory prices are being obtained; the better sorts of house coal can hardly be produced in sufficient quantities. Output in coke has been raised considerably of late, and some think that instead of the scarcity in coke previously complained of, a surplus in output will soon cause quotations to fall off.

German import in iron and steel during the first ten months of the present year was, according to the *Rheinisch-Westphalische Zeitung*, 854,936 t., against 692,558 t. for the same period last year, and 416,722 t. in 1898; export was 1,255,021 t., against 1,274,291 t. in 1899 and 1,364,626 t. in 1898. Import in pig iron was 626,308 t.—588,293 t. coming from Great Britain and 16,502 t. from America—against 505,145 t. in 1899 and 310,818 t. in 1898; export in pig iron was 103,990 t., against 152,374 t. in 1899, and 150,631 t. in 1898. In scrap iron import was 91,128 t.—36,430 t. coming from Holland—against 53,955 t. and 15,271 t.; export was 42,008 t., against 44,745 t. and 75,087 t. Import in finished iron was 137,500 t., against 133,458 t. in 1899, and 90,633 t. in 1898; export in finished iron was 1,109,033 t., against, 1077,172 t. in 1899, and 1,138,908 t. in 1898.

The Austro-Hungarian iron trade is in a perfectly lifeless condition, the stagnation in the building trades and in the manufacturing departments having caused prices to drop continually. The next few weeks are sure to be exceedingly quiet, and it is doubtful whether the New Year will bring the revival which many anticipate for January or February, and which both producers and buyers are sure to welcome, as the last few months have been so very dull.

The present state of the Austro-Hungarian coal market is very different from that of last year. Not only has the want of sufficient supplies long ceased to be a general complaint, but, in a good many cases, stocks are reported to have accumulated rather alarmingly, partly on account of the limited demand for house coal, and also because the consumers of engine coal had purchased heavily some weeks ago in order to prevent last year's calamity from being again experienced. There are more offers than buyers on the coal market now, and prices are very much inclined to give way. Only coke, and coal for coke making, are as strong as ever.

Little business was done on the Belgian iron market last week, the demand for iron and steel being very dull; prices show a tendency to decrease. The same must be told of the French iron trade, employment in the different departments being very limited.

An explosion in the Saint-Louis shaft of the Aniche colliery last week caused the death of fifty persons; eight men were seriously injured, while eighteen are still missing.

The Union of Swedish Ironmasters, at their autumn meeting held on the 24th of November, resolved to reduce their quotations for bars £1 p.t., and so the present price for malleable iron bars would be £12 10s. p.t., free Gothenburg; rolled iron, £11 5s.

The Italian mining industries are stated to own 1404 works, employing 57,000 men; value of annual output is statistically stated to amount on 72,000,000 lire. Production of zinc is 132,000 t. annually; lead, 32,000 t.; and iron, 200,000 t. Output of copper has considerably increased of late; ten years ago there were only eleven copper mines, employing 1500 men, and the annual production was 22,682 t. At present twenty-six mines employ 1800 men, and the output is 95,000 t. annually. In 1890 the sulphur pits of Sicily and the Romagna yielded 300,000 t.; in 1899 they produced 500,000 t.

AMERICAN STEEL FOR SHIPBUILDING.

IN our impression of 23rd ult. we commented on the rejection of American steel ship plates delivered to Workman, Clark, and Co., of Belfast. The rejection, it has now been made quite clear, was, as we then stated, more the result of a technical inadvertence than of any radical defect in manufacture. This was, in point of fact, the omission to procure before despatch from the American works a Lloyd's inspection certificate, such as could be recognised in the United Kingdom. It was owing, we understand, to test marks having been noticed on the plates by Lloyd's surveyor in the Belfast yard, for which no corresponding advice notes had been received through the usual official channels, that the question arose in Belfast, while at the same time the matter had become subject of question as well in the United States. The makers were, as stated in our former note, Lukens and Co., of Coatesville, Pa., who have now given a detailed explanation of the occurrence. "The plates," they state, "were made and inspected in Philadelphia before shipment by the Pittsburgh Testing Laboratory, who for seven years past have been inspecting all steel plates for ships built in this country under the British Lloyd's rules."

After the plates were shipped the Pittsburgh Testing Laboratory stated they were not appointed as yet—in fact, had been refused up to that time—to act as surveyors or inspectors for export plates, because not well known in shipping circles on the other side of the Atlantic. They were therefore unable to give a Lloyd's certificate for export work, unless, as they fully expected, arrangements could yet be made with the London Board to act as Lloyd's surveyors on foreign orders. Meantime the plates had gone forward, and no Lloyd inspection certificate that would be recognised in Great Britain was obtainable.

To avoid trouble in the future in furnishing steel to fulfil Lloyd's requirements, arrangements have now been made for a Lloyd's surveyor to live in Philadelphia and look after such business in that district.

LAUNCHES AND TRIAL TRIPS.

TABARISTAN, steel screw steamer; built by, Wm. Gray and Co., Limited; to the order of, Frank C. Strick and Co., Limited, Swansea and London; dimensions, 379ft. 6in., 45ft., and 26ft. 10in; engines, triple-expansion, over 3100 horse-power, 29in., 46in., 77in., by 48in. stroke, pressure 180 lb.; constructed by, the builders; fitted with Howden's forced draught; trial trip, November 28th; 14 knots.

FIRDA, wood cargo steamer; built by, Mr. J. Hauge, Haugecund, Norway; to the order of, Adolph Halvorsen, Esq., of Bergen; to carry, 850 tons deadweight; engines, triple-expansion, about 380 indicated horse-power, 12½in., 20in., 32in., by 26in. stroke; constructed by, The Laxevaags Engineering and Shipbuilding Company, of Bergen; trial trip, December 3rd; 10 knots.

EAST POINT, steel screw steamer; built by, Joseph L. Thompson and Sons, Limited; to the order of, The Norfolk and North American Steamship Company; dimensions, 404ft., 51ft., 30ft. 6in., moulded; engines, triple-expansion, 2300 indicated horse-power, 25in., 43in., 74in., by 48in. stroke, pressure 200 lb.; constructed by, J. Dickinson and Sons, Limited; Phorson's hydraulic trigger used in the launching; launch, December 5th.

MYSTIC, steel screw steamer; built by, C. S. Swan and Hunter, Limited; to the order of, The English and American Steamship Company, Limited; dimensions, 359ft., 46ft. ½in., 30ft. 1in.; to carry, 6000 tons deadweight; engines, triple-expansion, 23½in., 39in., 66in., by 48in. stroke, pressure 180 lb.; constructed by, The Wallsend Slipway and Engineering Company, Limited; launch, December 6th.

OFFENBACH; built by, Wigham Richardson and Co., Limited; to the order of, Deutsche-Australische D.G., of Hamburg; dimensions, 390ft., 48ft.; engines, four-crank quadruple-expansion, Y. S. and T. system; constructed by, the builders; trial trip, December 11th; 12¾ knots.

TRADE AND BUSINESS ANNOUNCEMENTS.

MR. ARTHUR ELLIS has been appointed chief electrical engineer for lighting and traction at Cardiff.

WE are informed that Mr. John Price has arranged a partnership for American inspection of railway material, &c., with Mr. Carl Virgin, of Baltimore.

MR. A. HUGH SEABROOK, A.M.I. Mech. E., A.M.I.E.E., assistant engineer, borough electricity works, Hampstead, has been appointed engineer to the Barking electricity works.

MR. WILLIAM BASIL DIXON, late general manager for John Penn and Sons, is about to carry on business as a consulting engineer, at 211, Mansion House-chambers, 11, Queen Victoria-street.

WM. SIMONS AND CO., LIMITED, Renfrew, have received another order from the Russian Government to construct a powerful barge-loading dredger. This is the the second order for dredgers they have received from Russia within the past month.

THE United Alkali Company, Limited, of Liverpool, has erected a plant at its Sullivan Works, Widnes, for the manufacture of carbide of calcium, which is a new industry with this company. The carbide department is under the management of Mr. J. Bastick, electrical engineer.

WE understand that the practice of the late Chas. Henry Driver, F.R.I.B.A., A.I.C.E., of 17, Victoria-street, Westminster, is to be carried on by his eldest son, Mr. C. H. Driver, in conjunction with Mr. Stanley Barrett, architect and surveyor, under the style of Barrett and Driver. The practice will be transferred to Mr. Barrett's office, 53, Blomfield-road, Maida Vale, W.

CATALOGUES.

JOHN KIRKALDY, LIMITED, Leadenhall-street, London, has issued a new catalogue, showing and explaining fully the various heaters, distilling condensers, feed filters and evaporators, and auxiliary surface condensers of the most improved designs. The book is well got up, and contains fifty steamer plans, with the necessary spaces for filling in and retaining every detail connected with ship or machinery from the signal letter to the cargo capacities, &c., for instant reference.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

29th November, 1900.

21,576. ADVERTISING MACHINES, A. N. McGray, London.
21,577. MAGIC TENT, W. Jinkings, London.
21,578. SWITCH and CUT-OUT COMBINED, W. J. Fryer, London.
21,579. LEAVES for KITCHEN TABLES, J. Norval, Glasgow.
21,580. WASH TUB SCREW-DOWN VALVE TAP, A. Morrison, Edinburgh.
21,581. SAND MOULDS, H. and H. W. Gibbons, Hungerford, Berks.
21,582. PISTON SPRINGS, J. W. Hacking, Manchester.
21,583. METHOD of HUMIDIFYING YARN, W. Tattersall, Bradford.
21,584. RIM BRAKE, R. C. Macdonald, Foyers Lochness, N.B.
21,585. LIFE GUARD for ELECTRIC CARS, A. Hudson, Bolton.
21,586. TEA BASKETS, W. R. Stokes and T. Holt, Leicester.
21,587. BRICK-MAKING MACHINES, T. C. Fawcett, Limited, and J. W. Bottomley, Halifax.
21,588. COMBINING ACETYLENE GAS with AIR, J. H. Cox, London.
21,589. BICYCLE BRAKES, C. H. Richards, Colchester.
21,590. SWINGING BRIDGES, A. Shaw and J. McPherson, Glasgow.
21,591. DOMESTIC FIRE-GRATES, J. J. Chavasse, Birmingham.
21,592. SAFETY VALVE, R. L. Ross, Portrush, Co. Antrim.
21,593. SHARPENING RAZORS, T. G. Allen, jun., Nairn, N.B.
21,594. DENOTING SPEEDS of PHOTOGRAPHIC SHUTTERS, A. L. Adams, London.
21,595. BEER ENGINES, E. Reece, Manchester.
21,596. ROOFS, C. Bollé.—(*G. Bruck, Germany.*)
21,597. RIB-TIPS of UMBRELLAS, W. Holland, jun., Birmingham.
21,598. FIRE-ESCAPES, J. M. Swift, Glasgow.
21,599. LIFE-SAVING APPARATUS, G. Plummer, Washington, D.C.
21,600. MACHINES for GRINDING KNIVES, J. N. Nutt.—(*A. Johnston, United States.*)
21,601. FURNACES, F. Hughes, London.
21,602. POSTAGE STAMP AFFIXERS, E. M. Harington, London.
21,603. GRIP, R. J. R. Caines, London.
21,604. LINEN WASHER, F. Zimmerli, London.
21,605. A TOY, C. H. Dearing, London.
21,606. MEASURING GRANULAR MATERIALS, W. Benscher.—(*P. Kleber and T. Berghauer, Germany.*)
21,607. BINDERS for LADIES' HAIR, H. Carter, London.
21,608. TUBULAR BOILERS, G. H. Mann and J. Clayton, London.
21,609. ALTERING ANGLES of ROLLED IRON, F. Morfitt, London.
21,610. A NEW GAME of SKILL, G. H. Smith, London.
21,611. SYSTEM for the LIQUEFACTION of AIR, C. Joly, London.
21,612. MANUFACTURE of SOLDERING LIQUIDS, I. Levy, London.
21,613. MECHANICAL MUSICAL INSTRUMENTS, L. Hupfeld, London.
21,614. BRIDLES for PAINTERS' BRUSHES, G. A. Siday, London.
21,615. SOCKET JOINTS of POLES, E. H. Chambers, London.
21,616. LOCOMOTIVE-SANDING DEVICES, The Economy Locomotive Sander Company and J. C. Hooper, London.
21,617. ELECTRICAL FUSE DISTRIBUTION, C. E. Zimdars, London.
21,618. STEERING WHEELS, M. Brooke and J. W. Brooke and Co., Limited, London.
21,619. MOTIVE POWER ENGINES, W. Foxton and D. Thubrow, London.
21,620. DRIVING MECHANISM, W. Foxton and D. Thubrow, London.
21,621. ROUNDABOUTS, J. W. Russom, London.
21,622. SUPPLYING AIR to GAS BURNERS, A. J. Boult.—(*The New Process Lighting Company, United States.*)
21,623. TREATMENT of ORES, H. W. Wallis, London.
21,624. APPARATUS for COPYING PURPOSES, K. R. Walker, London.
21,625. ANIMAL TRAPS, E. Lawrence, London.
21,626. PRODUCTION of MARGARINE, J. H. G. Neisse and J. H. Boll, London.
21,627. EXPLOSIVE COMPOUNDS, N. Cejpek, London.
21,628. MERCERISING MACHINES, F. Shuman, London.
21,629. ELECTRICAL ENERGY, W. Du B. Duddell, London.
21,630. GUN CARRIAGE, O. Imray.—(*Deutsche Waffen and Munitions Fabriken, Germany.*)
21,631. WINDLASSES, M. T. and J. E. Kane, London.
21,632. KNIFE-GRINDING MACHINERY, J. W. Mackenzie.—(*C. E. Hazelhurst and W. A. Breed, United States.*)
21,633. BANDOLIER, H. R. Hammond, London.
21,634. RAILWAY CHAIRS, T. M. Rhys, Liverpool.
21,635. TERMINALS, H. S. Martin, Liverpool.
21,636. FIXING ARTIFICIAL TOOTH CROWNS, E. Nagy, Liverpool.
21,637. STAPLES for HOLDING PIPES, T. B. Sauer, Liverpool
21,638. CONNECTING UNIONS for PIPE JOINTS, F. Kaeferle, Liverpool.
21,639. ADVERTISING CLOCKS, E. Davies, Birmingham.
21,640. CYCLE CRANK, S. Elliott, London.
21,641. COKE, A. Custodis, London.
21,642. ELECTRIC FUSES, J. C. A. Ward, London.
21,643. MANUFACTURE of BOOTS and SHOES, C. W. Phipps, London.
21,644. ELECTRICAL DISTRIBUTION SYSTEM, H. R. Kent, London.
21,645. ELECTRIC SWITCHES, Clarke, Chapman, and Co., Limited, and A. L. Forster, London.
21,646. BRAKES for RAILWAY WAGONS, R. G. Miller, London.
21,647. SEPARATING IMPURITIES from STEAM, M. M. Brophy, London.
21,648. ARTIFICIAL TEETH, R. Brewster, London.
21,649. EXPLOSION ENGINES, A. Mietz and C. W. Weiss, London.
21,650. APPARATUS for WASHING FLUID, E. A. Everard, London.
21,651. STEAM TRAPS, R. Parsons, London.
21,652. VARIABLE SPEED GEARING, W. Maybach, London.
21,653. MASSAGE MACHINE, F. King, London.
21,654. TOY GUNS, J. S. Renvoize, London.

30th November, 1900.

21,655. ADJUSTABLE PIPE WRENCH, D. Stewart, Glasgow.
21,656. ADJUSTABLE WIRE COUPLINGS, T. Johnson, Burslem.
21,657. LAGS for TEXTILE MACHINERY, J. Richardson, Leeds.
21,658. INSTANTANEOUS FLASH-LIGHT IGNITER, C. G. Brett, London.
21,659. DUST SHIELD for AXLES, J. O. Ladds and E. Selby.—(*A. W. Pigott, Queensland.*)
21,660. HOLDER for ELECTRIC GLOBES, G. H. Ide, Birmingham.
21,661. PRODUCING AIR TUBES of TIRES, F. Hulme, Manchester.
21,662. CYCLE-DRIVING CHAINS, F. Hulme, Manchester.
21,663. VELOCIPEDES, F. Hulme, Manchester.
21,664. CASKS and TUBS, &c., F. J. Clinch-Jones, Birmingham.
21,665. DYEING WOOLLEN YARNS, R. Mellor, Huddersfield.
21,666. DROP-SIDE COTS, J. E. Hoskins, Birmingham.
21,667. NON-RETURN or LIFT VALVES, C. C. Lapsley, Liverpool.
21,668. TIME-CHECKING APPARATUS, H. Dyson, Manchester.
21,669. REFLECTOR for ELECTRIC LIGHTS, S. Hall, Manchester.
21,670. STYLOGRAPHIC WRITING PEN, W. K. Carew, Dublin.
21,671. SELF-FEEDER for PRINTING MACHINES, W. H. Clegg, Burnley.
21,672. EXTRACTING CORKS from BOTTLES, G. Smith.—(*G. A. Smith, Canada.*)
21,673. AMMUNITION HOISTS, A. T. Dawson and J. Horne, Newcastle-on-Tyne.
21,674. SUPPORTING MOTORS, J. Campbell, A. Hird, and A. B. Blackburn, Sheffield.
21,675. PUZZLE, F. Tibbenham, Ipswich.
21,676. BUCKET CONVEYORS, M. Blake and R. H. Smart, Greenock.
21,677. BEARING for CARRYING GRINDSTONES, W. Lewis, Redditch.
21,678. CONTENTS VIEWING BOX, P., L., and D. Tierney, Dublin.
21,679. BRAKING and STOPPING DEVICE, J. J. Weller, Berlin.
21,680. IMPROVEMENTS in TOBACCO-SMOKING PIPES, I. George, London.
21,681. PORTABLE GAS-PRODUCING LAMP, H. H. Beehndel, London.
21,682. TOY FIGURES, A. Strenitz, London.
21,683. WATCHES, N. Crowther, London.
21,684. PNEUMATIC SIGNALLING, J. P. O'Donnell, London.
21,685. MOVABLE RINGS, A. G. Danisy-Martin and P. Reingard, London.
21,686. ROAD VEHICLES, F. Shaw, London.
21,687. BOOTS and SHOES, G. H. and A. W. Faire, London.
21,688. LACE MAKING, A. Tatham and C. Maltby, London.
21,689. TIME-CHECKING DEVICES, H. G. M. Phillips, London.
21,690. STARTING EXPLOSION MOTORS, J. W. Hinchley, London.
21,691. LOCKS, T. Barker, Manchester.
21,692. URINALS, J. Ducket and Son, Limited, and J. W. Bullock, Burnley.
21,693. STRADVING MOTION of a BEAM, J. Veevers, Burnley.
21,694. FINDING the NUMERICAL POSITION of a SHOOTING PARTY, F.-H. R. B. Liebenrood, Sidcup.
21,695. KETTLES, H. J. Wheeler, London.
21,696. OPENING and CLOSING FANLIGHTS, T. Jones, London.
21,697. APPARATUS for PLAYING GAMES, F. G. Galley, London.
21,698. MAKING HEADWEAR for LADIES, F. Swain, London.
21,699. SPACING in LINOTYPE MACHINES, W. H. Lock and W. Fletcher, London.
21,700. TELEPHONY, L. Sterne.—(*S. B. Fowler, United States.*)
21,701. TELEPHONY, L. Sterne.—(*S. B. Fowler, United States.*)
21,702. OPERATING DYNAMOS, The British Thomson-Houston Company, Limited.—(*W. le R. Emmet, United States.*)
21,703. ELECTRICAL DISTRIBUTION, The British Thomson-Houston Company, Limited. — (*R. Fleming, United States.*)
21,704. ELECTRICAL DISTRIBUTION, The British Thomson-Houston Company, Limited.—(*E. J. Berg, United States.*)
21,705. PINS, J. Quine, London.
21,706. TOE CLIPS for BICYCLES, W. C. Hunt, Birmingham.
21,707. SCORING DEVICE for GAMES, E. McL. Blair, London.
21,708. REVERSING COUPLING for MOTOR, J. H. Smiles, London.
21,709. PRODUCING PERFUME, G. W. Johnson.—(*A. Verley, France.*)
21,710. WHEEL BRAKE, G., H. F., and A. A. Parrott, London.
21,711. PHOTOGRAPHIC DEVELOPING DISH, E. B. Fox London.
21,712. DREDGERS, W. McKeegan, London.
21,713. CANNING FRUIT, Lawton's Patents, Ltd., and A. W. Lawton, London.
21,714. MAKING BOOTS and SHOES, J. W. Jones, London.
21,715. MACHINE for MAKING BOTTLES, L. Grote, London.
21,716. CONSTRUCTION of ARC LAMPS, C. Oliver, London.
21,717. DRYING FRAME, A. C. Sharpell and C. Gutmann, London.
21,718. SAILING APPARATUS, W. P. Thompson.—(*G. Breed, R. E. Breed, jun., and J. M. Ash, jun., United States.*)
21,719. WALL PLUGS, W. P. Thompson.—(*I. Friedinger, Austria.*)
21,720. CALCULATING MACHINE, J. Pallweber, A. Kolbe, and A. Greeff, Liverpool.
21,721. BASKETS, E. Farrar, Liverpool.
21,722. TROLLEY-WIRE CONDUCTORS, G. E. Heyl-Dia, Liverpool.
21,723. APPLYING DRESSINGS to BOOTS, R. Ellinger, Liverpool.
21,724. CLEANING WATER-TUBE BOILERS, K. Hussy, Liverpool.
21,725. MANUFACTURE of SLAG WOOL, G. A. Herdman, London.
21,726. INTERNAL COMBUSTION ENGINES, J. P. Fox, London.
21,727. WATER GAUGE for STEAM GENERATOR, K. Goub, London.
21,728. FIRE-RESISTING FLOORS, T. R. W. Mossman, London.
21,729. FOLDING BEDS, P. Hirsch and I. Picker, London.
21,730. SINGLE-ACTING ENGINE PISTON, J. S. V. Bickford, London.
21,731. INDIGO, O. Imray.—(*Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
21,732. CUTTING OUT MAIN CONDUCTORS, Siemens Bros. and Co., Limited.—(*Siemens and Halske, Actien Gesellschaft, Germany.*)
21,733. CHARGING of MOTOR ENGINES, B. H. Thwaite, London.
21,734. STILL, S. Bessonoff, London.
21,735. NEWSPAPERS, A. E. Farrants, London.
21,736. ELECTRICALLY LIGHTING TRAINS, A. B. Gill, London.
21,737. RECOVERING WASTE WATER and PULP, A. Faust, London.
21,738. TABLE for SCULLERY, P. H. Schaarschmidt, London.
21,739. SUPPORTING SHEETS of MATERIAL, F. Bruder, London.
21,740. DYNAMOS, W. Langdon-Davies and A. Soames, London.
21,741. TOBACCO PIPES, H. P. P. Phelips, London.
21,742. DISTRIBUTING FLUID, A. J. Boult.—(*E. Lara-Herrera, Spain.*)
21,743. MACHINE GUNS, A. J. Boult.—(*G. Perino, Italy.*)
21,744. GAS BURNER DEVICE, A. J. Boult.—(*W. Frenz, Germany.*)
21,745. DOUBLE-ACTING MEMBRANE PUMPS, E. Rasch, London.
21,746. INCANDESCENT GAS BURNERS, J. B. de Lery, London.
21,747. CHECK VALVES for PUMPS, J. S. Wyndham, London.
21,748. WRITING DESK, G. Watson, London.
21,749. BOOT, H. H. Leigh.—(*C. S. D. Leslie, India.*)

21,750. Nail Screws for Boots and Shoes, R. O. Craig, London.
21,751. Thrashing Machine, A. Shuttleworth and R. Gamble, London.
21,752. Generators for Acetylene, H. E. Baker, London.
21,753. Looms, F. A. Mills, London.
21,754. Looms, F. A. Mills, London.
21,755. Spectacle Attachment, D. Rugg, London.

1st December, 1900.

21,756. Spinning Frames, S. Berard, Kingston-on-Thames.
21,757. Washing Clothes, W. H. Duchworth and J. H. Cunliffe, Blackburn.
21,758. Brakes for Cycles, G. F. Bull, Birmingham.
21,759. Electro-deposition of Metal, S. Cowper-Coles, London.
21,760. Switch Points of Railways, H. A. Thomson, Glasgow.
21,761. Carrier for Golf Club, H. J. Coad, Portsmouth.
21,762. Telescopic Bed for Hospitals, W. Allan, London.
21,763. Incubators for Eggs, J. T. Kerfoot, Liverpool.
21,764. Dyeing Fibres, R. C. H. Bonsor and W. McGhee, jun., Bradford.
21,765. Locks, D. and E. Beards and D. Beards, jun., Wolverhampton.
21,766. Apparatus for Sieving Milk, J. Milne, Birkenhead.
21,767. Springs, D. S. Birrell and The Firth Company, Ltd., Liverpool.
21,768. Water-tube Boilers, G. W. Blackburn, Leeds.
21,769. Turning the Ends of Pipes, R. Sutcliffe, Leeds.
21,770. Brushes, W. Dederich, London.
21,771. Cleats for Blind Cords, J. J. James, Birmingham.
21,772. Testing Eggs, J., A., and G. Lyons, and The Lyons Standard Egg Testing and Grading Machine Company, Limited, Manchester.
21,773. Folding Chairs, P. A. Lamberg, Liverpool.
21,774. Crochet Hooks, E. B. Smith Bartlett, Birmingham.
21,775. Gullevs, J. E. Radford, A. W. Dicks, and E. Greaves, Derby.
21,776. Heating Coal, &c., J. W. McBeath, Newcastle-on-Tyne.
21,777. Tee Iron Rolling, F. C. Wesson, Moxley, near Wednesbury.
21,778. Tool for Cleaning out Mortise Holes, H. B. Richards and T. Barton, London.
21,779. Filling Bottles under Pressure, J. Fletcher, London.
21,780. Billiard Marker, G. J. and S. H. Sershall, Birmingham.
21,781. Generating Steam, C. Bollé.—(*A. Scharffe, China.*)
21,782. Washing Clothes, W. Travis, Manchester.
21,783. Horse-shoe Pads, A. Dales, Manchester.
21,784. Closing Water-tight Bulkhead Doors, W. and A. R. Crawford, Glasgow.
21,785. "Flax Holders" for Hackling Machines, A. J. Morrow, Lisburn, Co. Down.
21,786. Mercerising Cotton Woven Fabrics, H. B. Thorp, Manchester.
21,787. Wall Plugs Securing Door Frames, C. Erb, Paris.
21,788. Staying Folding Structures, F. J. Cassidy, Liverpool.
21,789. Copy Holder for Manuscripts, F. J. Cassidy, Liverpool.
21,790. Automatic Fog Signals, E. Hutton, Birmingham.
21,791. Hydraulic Rams, H. V. Blake, Manchester.
21,792. Fumigating Appliance, J. and A. Macdonald, Glasgow.
21,793. Screwing Die, J. Barker and W. and T. Spence, Leeds.
21,794. Hammers, W. Kimberley and The David Kimberley and Sons Tool Manufacturing Company, Limited, Birmingham.
21,795. Poultry Food, N. Mayer, London.
21,796. Waterproof Varnish, A. and H. Thorpe, Leeds.
21,797. Attachment for Letter-boxes, C. D. Sculthorp, London.
21,798. Lap Roller for Scutching Machines, W. B. Soman, Manchester.
21,799. Steps, J. B. Sangwin, London.
21,800. Aerial Navigation Appliances, T. Moy, London.
21,801. Power Apparatus, H. Christiansen and P. C. Jacobsen, London.
21,802. Garment Suspenders, R. Scholz, London.
21,803. Safety Grip Mechanism for Lifts, E. Hill, London.
21,804. Insulating Materials, E. A. Claremont, London.
21,805. Rail Coupling, F. Scheinig, London.
21,806. Trolleys for Electric Traction, P. McCullough, Liverpool.
21,807. Cigars, A. H. Morrell, Liverpool.
21,808. Taking-up Valve Seatings, W. Dowie, Liverpool.
21,809. Teapots, M. S. Watson, Liverpool.
21,810. Soap-kneading Machine, A. des Cressonnières, Liverpool.
21,811. Cigarette-making Machine, G. Calberla, London.
21,812. Arc Lamps, L. W. Emerick, London.
21,813. Brake for Railway Wagons, E. J. Hill, London.
21,814. Increasing Adhesion of Wheels, A. Riasse, London.
21,815. Armatures, V. I. Feeny.—(*Allgemeine Elektricitäts Gesellschaft, Germany.*)
21,816. Globes, F. W. Schroeder, J. Peters, and P. W. Moran, London.
21,817. Process for Colour Photography, B. Acres, London.
21,818. Mixing Gases in Flues, F. W. M. Kirchman, London.
21,819. Cyanamide, G. W. Johnson.—(*Deutsche Gold and Silber Scheide-Anstalt vormals Rössler, Germany.*)
21,820. Alkali Cyanides, G. W. Johnson.—(*Deutsche Gold and Silber Scheide-Anstalt vormals Rössler, Germany.*)
21,821. Indigo, B. Willcox.—(*Badische Anilin and Soda Fabrik, Germany.*)
21,822. Brake Mechanism for Cycles, C. Inwood, Gravesend.
21,823. Game of Skill, V. A. H. Guinent and A. J. Lely, London.
21,824. Belt, L. G. Freedman, London.
21,825. Decorticating Fibre, H. Plassan.—(*J. G. Hernandez, Cuba.*)
21,826. Motor Vehicles, H. H. Lake.—(*A. Sternberg, Germany.*)
21,827. Electric Incandescent Lamps, Societa Edison per la Fabbricazione delle Lampade Eng. C. Clerici and Company, London.
21,828. Storing of Grain, A. R. Kempton, London.
21,829. Pattern Card Books, H. Broadbent and Co. Limited, London.
21,830. Automatic Fire-lighting Apparatus, H. K. Morley, London.
21,831. Gas Fires, W. Edgar, London.

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21,832. Revolving Plate Stock for Screwing, J. Boag, Glasgow.
21,833. Stitch Separator for Sewing Machines, M. H. Pearson, Leicester.
21,834. Cycle Brake, E. Morris, Waterford.
21,835. Making Cartridge Cases, S. Cowper-Coles, London.
21,836. Sewing Machines, D. M. Seaton and G. J. Stevens, Bradford.
21,837. Electricity Meters, G. W. Lummis-Patterson, Newcastle-upon-Tyne.
21,838. Obtaining Electric Impulses, G. B. Batten, London.
21,839. Free-wheel, S. Dorsett, W. Hayward, H. B. Smith, W. Woods, and W. F. Watts, Wolverhampton.
21,840. Ascertaining when Camera Films are in Focus, A. Coats, jun., Paisley.
21,841. Castors for Furniture, T. and R. T. Singleton, Halifax.
21,842. Steam Traps, T. Allison and F. Shaw, Halifax.
21,843. Rail Joints for Railways, J. Garry, Newcastle-on-Tyne.
21,844. Signal Lamps, J. E. Bavidge, W. E. Hood, and J. R. C. Bell, Newcastle-on-Tyne.
21,845. Chimney Cowl, A. W. Astle and T. Coleman, Derby.
21,846. Knives for Opening Tins, T. F. Evans, Manchester.
21,847. Speed Regulators, J. Lumb, Elland.
21,848. Optical Apparatus, J. A. and W. T. Purves, Edinburgh.
21,849. Folding Fire-box, H. Looney, Burgess Hill, Sussex.
21,850. Game of Skill, A. D. and B. N. Prangley, Liverpool.
21,851. Saddle Pillar for Velocipedes, E. Clarke, Manchester.
21,852. Electric Traction, E. H. Tyler and A. G. Hansard, London.
21,853. The Permanent Crease, R. D. Kay, Honor Oak Park, Kent.
21,854. Letter-box, S. Preston, London.
21,855. Automatic Point Regulator, L. V. Jennings, Dublin.
21,856. Blackboards, J. S. Morriss and W. J. E. Crane, London.
21,857. Means for Stopping Vehicles, T. Heather, London.
21,858. Electrical Contacts, M. Cantar and The Prof. Braun's Telegraphic Gesellschaft mit Beschränkter Haftung, London.
21,859. Spring Forks for Velocipedes, W. T. Lord, London.
21,860. Electric Meters, The British Thomson-Houston Company, Limited. — (*E. Thomson, United States.*)
21,861. Electric Boosters, The British Thomson-Houston Company, Limited.—(*B. M. Hewlett, United States.*)
21,862. Securing Pole-pieces to Electric Machines, The British Thomson-Houston Company, Limited.—(*H. G. Reist, United States.*)
21,863. Ships, J. Dickinson, London.
21,864. Carding Engine Condensers, E. Fairburn, London.
21,865. Propelling Ships' Boats, A. Hunnable, Romford, Essex.
21,866. Textile Fabric Sample Holder, H. L. Davis, London.
21,867. Spinning Spindles, C. Martin and H. Page, London.
21,868. Method of Cooling Houses, L. C. Reese, London.
21,869. Safety Appliance for Power Presses, A. Culpin, London.
21,870. Coin-freed Game Apparatus, W. Northorpe, London.
21,871. Ink Bottles, T. J. Prosser, London.
21,872. Manufacture of Floor Cloth, H. W. Godfrey, London.
21,873. Signalling with Steam Whistles, A. P. Horn, London.
21,874. Fish-plates for Permanent Way, L. H. Young, London.
21,875. Means for Detecting Firedamp, J. Ashworth, Nuneaton.
21,876. Clothes-drying Rack, C. and J. St. Hilaire, London.
21,877. Corrugated Expansion Tubes, W. G. Potter, Birmingham.
21,878. Cooling Railway Cars, W. G. Potter, Birmingham.
21,879. Lighting Theatre Stages, T. J. Digby, London.
21,880. Electric Device, E. F. Hoy and P. H. Bastre, London.
21,881. Apparatus for Holding Sacks, C. J. Moulton, London.
21,882. Transmission Gear for Cycles, W. Hillman, London.
21,883. Horseshoes, H. Biles, London.
21,884. Grinding Tools, W. H. Lock and M. Barr, London.
21,885. Process for Printing Fabrics, H. Werner, jun., London.
21,886. Electrical Accumulator, L. E. Lacroix, jun., London.
21,887. Handles for Mortar Boards, T. Messham, Liverpool.
21,888. Presses, J. Thomson and A. Petri, Liverpool.
21,889. Saw-sharpening Machine, F. Schmaltz, Liverpool.
21,890. Gas Burner, W. P. Thompson.—(*B. Jolles and Zietz and Bruno Gesellschaft mit beschränkter Haftung, Germany.*)
21,891. Magazines for Breech-loading Guns, &c., P. Jensen. — (*Krag - Jörgensen Gevaerkompagni, Norway.*)
21,892. Corsets for Use of Ladies, H. Fedra, London.
21,893. Hair Clamps, J. Balog, London.
21,894. Apparatus for Synchronising Clocks, N. F. Nalder and The Standard Time Company, Ltd, London.
21,895. Reading Meters for Vehicles, J. M. Black, London.
21,896. Fire-arms, L. B. Willoughby, London.
21,897. Dye-stuffs, H. E. Newton.—(*The Farbenfabriken vormals F. Bayer and Co., Germany.*)
21,898. Dye-stuffs, H. E. Newton.—(*The Farbenfabriken vormals F. Bayer and Co., Germany.*)
21,899. Funnels, A. P. Johnson, London.
21,900. Hair-retaining Device, J. Eschwege and M. G. Cohn, London.
21,901. Colouring Matter, C. D. Abel.—(*Actiengesellschaft für Anilin Fabrikation, Germany.*)
21,902. Colouring Matter, C. D. Abel.—(*Actiengesellschaft für Anilin Fabrikation, Germany.*)
21,903. Holding the Glass of Arc Lamps, F. J. Green, London.
21,904. Electric Resistance for Lamps, F. J. Green, London.
21,905. Automatic Musical Instrument, J. Carpentier, London.
21,906. Stand for Liquor Pots or Vessels, J. Challis, London.
21,907. Saving Life at Sea, N. Way and I. Fripp, London.
21,908. Heater for Water, W. M. Bindy, London.
21,909. Wireless Telegraphy, A. Blondel, London.
21,910. Manufacturing Bricks, &c., H. Alexander, London.
21,911. Cleansing in Fermenting Industries, A. Sjöö, London.
21,912. Vessel for Mixing Liquids, A. J. Boult.—(*C. Hromadnik, Germany.*)
21,913. Press for Making Facing Bricks, A. Clemens, London.
21,914. Treating Liquids, A. J. Boult.—(*C. Hromadnik, Germany.*)
21,915. Countershafts, S. W. Wardwell, London.
21,916. Book Holders, A. J. Boult.—(*M. Z. fu Rosario, Italy.*)
21,917. Mountings for Vehicle Lamps, W. Foxton, London.

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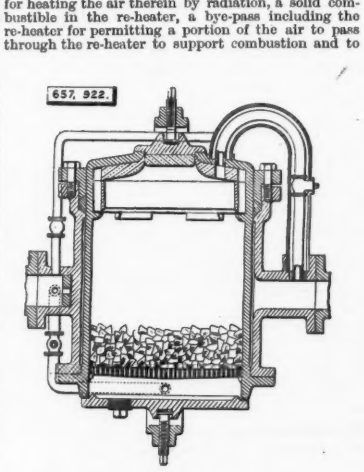
21,918. Double-barrel Guns, W. H. Brighton, London.
21,919. Football, W. C. Harris and J. A. W. Scott, Newcastle, Staffs.
21,920. Diaphragm Attachment for Phonographs, C. Jones, Blackburn.
21,921. Automatic Supply Machines, M. J. Adams, Leeds.
21,922. Controlling Speed, R. F. Collinge and H. H. Lindon, Liverpool.
21,923. Apparatus for Loading Coke, W. Oughton, Crook, R.S.O.
21,924. Lubricating Bearings, W. A. Entwistle, Liversedge, Yorks.
21,925. Adjustment for Flash-lamps, H. Biddell, London.
21,926. Rim Brake for Bicycles, E. M. Edwards, London.
21,927. Rim Brake for Motor Cars, J. Kelland, Plymouth.
21,928. Rust-proof Wire Mattresses, W. Jubb, York.
21,929. Fasteners for Window Sashes, S. Skerritt, Sheffield.
21,930. Soap Distributors, L. Galloway, Manchester.
21,931. Letting off Motions for Looms, W. Brigg, Bradford.
21,932. Warp Knitting Machines, H. Clark, Nottingham.
21,933. Electric Arc Lamps, Compton and Co., Limited, A. J. Hodgson, and J. W. Ewart, Chelmsford.
21,934. Ball Taps, W. Bradley, Castleton *vid* Sheffield.
21,935. Self-acting Mules, J. Moorhouse, Manchester.
21,936. Oil Cups, F. Hulme, Manchester.
21,937. Kilns or Muffle Furnaces, W. C. Hamilton, Glasgow.
21,938. Apparatus for Filling Bottles, T. Douglas, Glasgow.
21,939. Rubber Stencil, A. H. Wheeler, Birmingham.
21,940. High-pressure Water Tap, W. Bradley, Sheffield.
21,941. Straps for Winding Purposes, H. H. Waller, Halifax.
21,942. Picking Sticks, J. E. Shaw and T. Wood, Huddersfield.
21,943. Transmitting Power, F. E. Baker, Redditch.
21,944. Miners' Pick, A. Sedgwick, Clay Cross, Derbyshire.
21,945. Operating Railway Switches, W. J. Goudie, Glasgow.
21,946. Boats, C. F. Sultemeyer, Glasgow.
21,947. Air Ships, C. M. Richmond, Glasgow.
21,948. Concrete Mixers, S. P. McKelvey, Glasgow.
21,949. Raffing Borders of Breeches Together, E. Sohn, Manchester.
21,950. Parquet Floors, F. Bosshardt.—(*Société Anonyme Parqueterie Franco-Hongroise, Belgium.*)
21,951. Shoes for Horses, J. Andrew and F. Woodland, Manchester.
21,952. Dress Guards for Cabs, T. Rowley and J. Wallwork, Manchester.
21,953. Mechanical Toys, H. Fischer, Halifax.
21,954. Extracting Corks from Bottles, F. P. Williams, Manchester.
21,955. Manufacture of Bird Cages, S. H. Brittain, Birmingham.
21,956. Spool-making Machine, E. P. Brownell, London.
21,957. Tables, J. H. Abbott, London.
21,958. Lifting Garments from Dyeing Vats, J. Stewart, Dundee
21,959. Tobacco Pipe, J. E. Seary and O. E. Smith, London.
21,260. Caulking of Tile Roofings, G. A. Nebeling, Manchester.
21,961. Electric Fire Alarm, F. Gültling, London.
21,962. Adjuster for Electric Lamps, H. McGowan, London.
21,963. Ploughshares, F. T. Ruston and I. Wilderspin, London.
21,964. Collapsible Gate Roller Blind, B. Bennett, London.
21,965. Fire-blower and Screen, E. C. Morris and E. Field, London.
21,966. Coin-freed Delivery Apparatus, E. Martini, Charlottenburg, near Berlin.
21,967. Pantograph, N. Kotko, Charlottenburg, near Berlin.
21,968. Machines for Perforating, L. R. Damon, London.
21,969. Machines for Lasting Boots, H. H. Donovan, London.
21,970. Dyestuffs, M. Lange, London.
21,971. New Fatty Substance, L. Leclère, London.
21,972. Cutting Mitres, T. and J. H. Claughton, London.
21,973. Water Motor, W. T. Sugg, London.
21,974. Machinery for Discharging Gas Retorts, G. A. Brouder, London.
21,975. Holders for Matches, H. Braby, London.
21,976. Fire-lighter, H. Braby and C. Coutts, London.
21,977. Gasifiers for Internal Combustion Engines, W. A. Bole and E. Rund, London.
21,978. Collapsible Glass Holder, F. Riden, London.
21,979. Gyratory Mullers, A. C. Calkins and F. W. Braun, London.
21,980. Ore Pulveriser, A. C. Calkins and F. W. Braun, London.
21,981. Rotary Engines, A. Devereux, London.
21,982. Fluid-pressure Railway Brakes, J. B. O'Donnell, London.
21,983. Guides for Picture Trimming, P. E. Stevens, London.
21,984. Cartridge Belts, T. C. Orndorff, London.
21,985. Producing Scenic Representations, J. W. MacKenzie.—(*Dolores de Santa Maria d'Yberri-Fitch, United States.*)
21,986. Bedsteads, E. Michon, London.
21,987. Closet-seat Brackets, R. W. McDonald, London.
21,988. Straight Knitting Machines, R. W. James.—(*The Standard Machine Company, United States.*)
21,989. Playing Games with Balls, F. A. Ficker, London.
21,990. Chucks and Sleeves, J. Blamire, London.
21,991. Connections for Electrical Conductors, W. B. Cleveland, London.
21,992. Sewing Machine Horns, H. H. Lake.—(*Steam Heated Horn Company, United States.*)
21,993. Steering Mechanism for Vehicles and Boats, H. H. Lake.—(*Improvements Manufacturing Company, United States.*)
21,994. Manufacturing Tubes from Gelatinous Substances, H. H. Lake.—(*La Société Anonyme "Le Cirolenm," France.*)
21,995. Riding Saddles, W. Wi[illegible]my, London.
21,996. Valves for Pneu[illegible]ic T[illegible], C. A. G. Storz, London.
21,997. Atmospheric G[illegible] Bu[illegible]rs, P. Lacroix, London.
21,998. Letters for Adve[illegible] purposes, A. C. Amy and H. Battams, Londo[illegible]
21,999. Printing Machin[illegible] J. S. Morriss and B. Hall, London.
22,000. Speed Regulators, G. Rodfern.—(*A. Nathan, Italy.*)
22,001. Gear for Bicycle G. W. Elliott and W. Trewhella, London.
22,002. Pneumatic Horse Collars, G. and E. Schibalski, and T. Kutschka, London.
22,003. Trap for Animals, C. Herzberg, London.
22,004. Vehicle Hubs, W. P. Thompson.—(*F. F. Stowe, United States.*)
22,005. Lung-testing Apparatus, C. E. Howell, Liverpool.
22,006. Oscillating Thermometer, J. Hartig and P. Glaser, Liverpool.
22,007. Moving Cargo, R. A. Needham and R. L. Kemp, Liverpool.
22,008. Moulding n Sand, M. H. Morgan, Birmingham.
22,009. Breeching Ring for Horse Harness, W. Owen, Birmingham.
22,010. Connecting Electrical Conductors, W. B. Cleveland, London.
22,011. Polish Reviver, J. S. Sweet, London.
22,012. Fire-Alarm Apparatus, H. Plowman, London.
22,013. Cartridge Clip, G. Roth, London.
22,014. Water Supply Valves for Baths, H. L. Doulton, London
22,015. Fire-proof Floors, O. Imray.—(*C. F. Buente, United States.*)
22,016. Game Apparatus, A. Fenwick, London.
22,017. Dotting Devices for Automatic Card Feeders, C. O. Liebscher, London.
22 018. Folding Boxes, G. D. Howard.—(*W. F. Schroeder, United States.*)
22,019. Storage Batteries, A. Meygret, London.
22,020. Valves for Steam Pipes, A. L. Rapke, London.
22 021. Arc Lamps, J. Velle and the Mercury Cycle Manufacturing Company, Limited, London.
22,022. Storage Batteries, A. J. Boult.—(*L. Sauvan, France.*)
22,023. Swinging Hose Brackets, L. T. Foreman, London.
22,024. Hide-working Cylinders, A. J. Boult.—(*N. Leidgen and E. H. Munkwitz, United States.*)
22,025. Typewriting Machines, B. P. Tcherkassov, London.
22,026. Electric Wave Telegraphs, A. J. Boult.—(*American Wireless Telegraph Company, United States.*)
22,027. Generating Power, J. G. Nash, London.
22,028. Buttons or Fastening Devices, K. Suchy, London.
22,029. Automatically Inserting Pins in Card, C. Starmanns, London.
22,030. Gates for Elevator Hatchways, W. A. Cross, London.
22,031. Plough Attachment, F. Gale and J. Hemphill, London.
22,032. Advertising Apparatus, D. G. Hurd and A. McLeod, London.
22,033. Dyeing Machines, H. W. Church, London.
22,034. Making Blocks of Ice, G. F. Buckingham, London.
22,035. Operating Engine Valves, G. M. Gibson, London.
22,036. Printing Presses, E. Z. Taylor, London.
22,037. Taps, W. T. Hickinbotham, London.
22,038. Bearings for Loose Pulleys, F. Rohrbeck London.
22,039. Pneumatic Tires, A. Ducasble, London.
22,040. Bottles, J. Taylor, E. A. Hearn, and E. J. Wickenden, London.
22,041. Metallic Pipe Connections, J. P. Fullerton, London.
22,042. Motor Vehicles, H. L. Arnold, London.
22,043. Nut-tapping Machines, A. H. Riggs, London.
22,044. Shirt, G. Baldszun, London.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

657,922. Apparatus for Re-heating Compressed Air for Industrial Purposes, *T. A. Edison, Llewellyn Park, N.J.—Filed December 12th, 1899.*

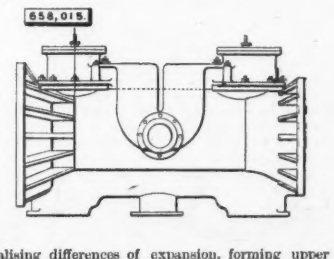
Claim.—An apparatus for heating air, comprising a pipe supplying compressed air from a source of supply to a translating device, a re-heater in said pipe for heating the air therein by radiation, a solid combustible in the re-heater, a bye-pass including the re-heater for permitting a portion of the air to pass through the re-heater to support combustion and to



be heated directly, and means to permit a drop in the air pressure between the inlet to said bye-pass, and the translating device to automatically cause air to flow through the bye-pass in quantity depending upon the consumption at the translating device, substantially as set forth.

658,015 Expansion-compensating Device for Steam Cylinders, *E. König, Aschersleben, Germany. — Filed June 23rd, 1900.*

Claim.—(1) A device for equalising differences of expansion in the inlet parts of superheated steam engines, which consists of a tubular connecting piece carrying a steam inlet socket, and a casing at each end for receiving the inlet valves, which casings are formed in one piece with the said connecting piece, and the latter being bent to the general form of a V shape in order to receive a spring action, substantially as described. (2) In a device such as described for



equalising differences of expansion, forming upper seat faces of annular shape on concentric walls of the double seat to inclose the whole valve, and thus allow the surfaces both of the seat and of the valve, which are acted on by fresh boiler steam and cylinder steam respectively, to be correctly calculated for equal expansion, and providing the seat disc, which carries the annular faces and fixing flange, with suitable openings for giving passage to the hot steam, substantially as described.

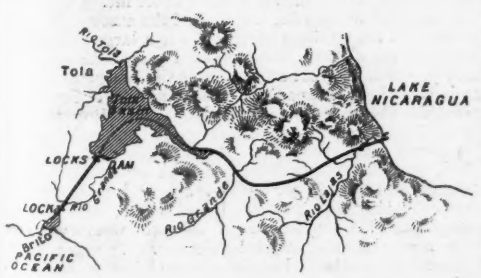
CENTRAL AMERICAN SHIP CANALS.

No. V.

IT is not too much to say that the whole world would benefit by the opening of a maritime canal between the Atlantic and Pacific oceans. To the United States such an enterprise has become of almost vital importance, not merely because of commercial, but also political considerations. The latter were perhaps better appreciated by the last generation of Americans than by those of to-day, though even as recently as June, 1896, they found remarkable expression in a report of a select committee of the Senate, to which had been referred one of the many Bills dealing with the construction of a canal across Nicaragua, which have from time to time occupied the attention of Congress. The document discussed at length the opposition offered by some of the transcontinental railroads, which were described as "seeking a present profit from the monopoly of transportation at the expense of their future prosperity."

In competing for the carrying trade that is furnished from Asiatic fields of production, they—the railroads—must ultimately be overwhelmed with the cheaper rates of water transportation through the Suez Canal to our Atlantic ports. The fight is unequal and they must succumb, and if they do all the carrying from the Pacific ports, they will still fall into bankruptcy, because their present policy impoverishes the commerce of the Pacific States. Nothing, indeed, can now save some of these railroads, except the filling up of our Pacific States with a vigorous European immigration. . . . There is not, in fact, any interest in any business enterprise in the United States that would not feel the impulse of this great movement in a new career of commerce and national power and influence, and share in its benefits. We have no undeveloped and prospective advantages as a commercial people that compare with those of our Western States in their virtual command of the trade of the countries bordering upon the Pacific Ocean. To do this work in a manner worthy our opportunities, we must shorten the line of water communication between our Atlantic and Pacific States. If we fail in this, we shall soon occupy a position, as a people, inferior to our kindred in Europe. . . . . It is the combination of these powers, through the Nicaragua Canal, that alone can establish that national unity and strength without which the chain of the Rocky Mountains may some day become the boundary between two great rival republics.

For at least half a century, ever since the admission of California into the Union, the canal question has occupied a foremost position in the minds of Americans. No subject has been more frequently discussed in the Federal Legislature, but seldom in a scientific spirit, and nearly always in a manner to suggest that at least a majority of the more prominent debaters cared less for the canal as a sound engineering and commercial enterprise than as means for the promotion of jobbery or party interests. The English public, having formed an ultra-unfavourable opinion of the condition and prospects of the Panama



undertaking, has allowed itself to be swayed to the opposite extreme in regard to that yet *de facto* myth, the Nicaragua Canal. Among a great majority of people, otherwise well-informed, there has until the last few weeks existed a concensus of opinion that serious work has been in progress for some considerable period along the Nicaragua route, and that, under the auspices of the United States Government, the enterprise was already within measurable distance of completion. For these very erroneous convictions some excuse may be found in the newspaper headlines so common during recent sessions of Congress, and the scanty and usually misleading information printed beneath.

It would be a long and thankless task to chronicle even the dates and most conspicuous incidents of the innumerable endeavours of politicians and promoters to closely identify the United States with the Nicaragua project. Let it here suffice to say that, in order to assist the construction of a canal under American protection, many treaties have been concluded between the United States Government and the Republics of Nicaragua and Costa Rica, some of which have been duly ratified by the Senate at Washington; that various concessions have been obtained and have successively lapsed on account of their owners' neglect or inability to comply with stipulations clearly expressed and recognised as reasonable; and that, prior to the appointment of the latest Canal Commission, at least a score surveys of proposed routes had been made, most of them under the patronage of the Federal Government and conducted by United States officials, with the net result of demonstrating that not a single one could be regarded as other than perfunctory and delusive as to the difficulties and cost of the undertaking.

Referring to quite recent times, it will be remembered that the 1898-99 session of Congress was very largely devoted to the consideration of Bills dealing with the question, "some of which were almost scandalous in the terms which they proposed between the United States Government and a company which has held a concession, but has been more anxious to sell out—at a profit—to the Government than to build a canal." These words are quoted from an article in THE ENGINEER of April 7th, 1899, and are more than justified by a crushing report which was submitted to the House of Representatives by its Committee on Interstate and Foreign Commerce two months before. From the same article, we may perhaps be permitted to quote the following remarks, as expressing in very apposite terms our appreciation of the actual position of affairs up to a few weeks since, or to be absolutely precise the 4th instant:—

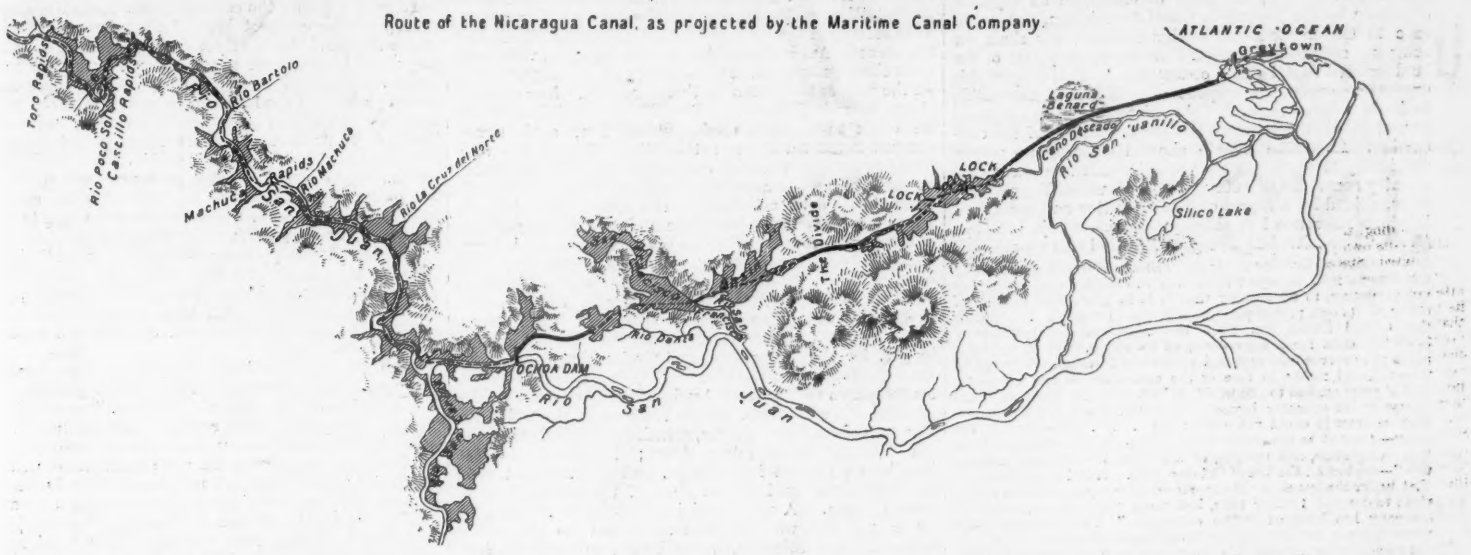
The enthusiasts and the interested parties have tried to make it appear to the people and the Government that some steps must be taken at once towards the construction of the canal, and that funds must therefore be at once appropriated. A very brief consideration of the status of the case will show that such arguments are fallacious, and that a "job" of some kind is likely to be behind them. In the first place, the United States has as yet no standing in the matter, it has no concessions or rights, and has acquired no territory. The negotiations for the first and the surveys for the second have yet to be made and approved, after which will come extensive final surveys and investigations, the preparation of general plans and estimates, and the working out of problems connected with the engineering works and difficulties, before anything can be done towards awarding contracts or undertaking construction. Consequently, there is no necessity for appropriating large sums of money until all the above preliminaries are at least in train, whereas as yet they are not even started so far as any definite project for the United States is concerned. All the reports and investigations by engineers and commissions up to the present time have been more or less hasty, superficial, or incomplete, and form little more than a basis on which to start a thorough comprehensive and trustworthy investigation. The very men who are eager for the appropriation of Government's money would decline any proposition towards their personal investment in the scheme.

A year later these words were unreservedly accepted as a fair statement of facts by one of the most influential of American technical periodicals. "It seems only too probable," wrote the editors, "that before this issue appears, the United States will have committed the egregious folly of blindly endorsing the Nicaragua Canal scheme."

The *prima facie* evidence in favour of Panama is extremely strong, and far more so because it is studied with absolute completeness, and is actually half completed. Nicaragua is a "project," pure and simple, based upon foundation little better than guess work. It has not yet received the endorsement of any engineering talent even approaching in character that which has completely approved the Panama route. It has never won the confidence of capital sufficiently to support any serious effort at construction. And this scheme, devoid of authoritative engineering endorsement, incapable of inspiring financial backing, the people of the United States are asked to adopt blindly, to give their verdict for hastily, before the evidence they themselves have ordered can be put in. It is competent to suspect the good sense or the good faith of those who urge such a course. The country will stultify itself, and dishonour its appointed advisers if it act before their report is presented. A million dollars has been appropriated for adequate study, and now frantic effort is being made to force a conclusion before the results can be presented.

The Western boom which followed the war with Mexico, the discovery of gold in California, and the admission of that State into the Union, induced a company then operating a line of communication across the isthmus by means of stage coaches and steamers on the river San Juan and Lake Nicaragua to survey the same route with a view to the promotion of a ship canal. This survey, dated 1850-52, was conducted by an American engineer, Mr. or Colonel, O.M. Childs, and was, perhaps, as thorough as most of its successors. Twenty years later, the United States Government despatched an expedition under Commander Lull, of the U.S. Navy, to re-survey practically the same route; and this was followed, in 1885, by another examination, directed by Lull's chief assistant, Lieutenant A. G. Menocal, of the Civil Engineer Corps of the Navy. Mr. Menocal in 1887 obtained from the Republic of Nicaragua a concession for the construction of an inter-oceanic ship canal, and then, becoming engineer-in-chief of the

Route of the Nicaragua Canal, as projected by the Maritime Canal Company.



Section of canal.	Length.	Width, top.	Width, bottom.	Mean depth.	Area of prism.
	Miles.	Ft.	Ft.	Ft.	Sq. ft.
Greytown to Lock No. 1	9·297	288	120	28	5712
Lock No. 1 to Lock No. 2, canal	1·258	210	120	30	4950
Lock No. 2 to Lock No. 3, canal	1·650	210	120	30	4950
Lock No. 2 to Lock No. 3, basin	1·762	—	—	30	—
Lock No. 3 to eastern divide cut, canal	2·917	80	80	30	2400
Lock No. 3 to eastern divide cut, Deseado basin	3·086	—	—	45	—
Western end of divide cut to Ochoa, canal	1·233	184	80	30	3673
Western end of divide cut to Ochoa, San Francisco basin	11·267	—	—	40	—
River San Juan to Toro Rapids	37·040	—	—	52	—
River San Juan, requiring to be dredged	27·500	—	125	28	—
Lake Nicaragua	56·500	—	150	50	—
Lake to Western divide cut, canal	1·565	210	120	30	4950
Western divide cut, canal	4·924	80	80	30	2400
Divide cut to east end of Tola basin, canal	2·519	184	80	30	3673
East end of Tola basin to Lock No. 4, basin	5·504	—	—	70	—
Lock No. 5 to Lock No. 6, canal	1·582	184	80	30	3673
Lock No. 6 to Brito Harbour, canal	·570	288	120	28	5717

Summary.

	Miles.
Canal excavation, east side	14·870
Canal excavation, west side	11·160
Six locks	·759
Canal in excavation	26·789
Deseado basins	4·848
San Francisco basin	11·267
Tola basin	5·504
Length of basins	21·619
River San Juan	64·540
Lake Nicaragua	57·500
Natural waterways	121·040
Total length of canal	169·448

Maritime Canal Company of Nicaragua, an American corporation to which this concession was transferred, conducted other surveys. In 1890 the company formulated a project for completing the canal within seven years and at a cost of £13,400,000, but two years later the plans were re-examined and the estimate increased to £17,600,000. Lake Nicaragua, which at its mean is 110ft. above the mean level of the oceans, was necessarily to be the summit level of the canal, of which the total length—from Greytown, on the Atlantic, to Brito, on the Pacific—was to be 169·448 miles. Of this distance, however, only 26·789 miles were to be excavated canal, the remainder being free navigation by the lake, the Rio San Juan, and through artificial basins in the valleys of the rivers Deseado, San Francisco, and Tola. Three locks each with a single chamber, were projected on either side of the summit level, all remarkably near the extremities of the canal, all 650ft. long and 70ft. wide, and with lifts ranging from 30ft. to 45ft. The main feature of the project, however, was a series of enormous dams, planned for the most part on untrustworthy soil, and otherwise wholly without precedent in sound engineering. The proposed dimensions of the several sections, as shown in the accompanying map of the contemplated route, are given in the table on page 605.

A few years sufficed to demonstrate that the Maritime Canal Company was nearing the end of its always scanty resources, that very little actual work had been accomplished, and that, under existing conditions, there was but slight prospect of further progress. Recognition of these facts led, first, to the appointment of the Ludlow Commission; and, secondly, to a movement which, if successful, would have constituted the United States Government a quasi-partner of the moribund company. The Government could not directly acquire the latter's rights, because the eighth article of the Cardenas-Menocal compact provided that "The present concession is transferable only to such company of execution as shall be organised by the Nicaragua Canal Association, and in no case to Governments or foreign Powers; nor shall the company cede to any foreign Government any part of the land granted to it by this concession." Yet, despite this explicit condition, the purpose of which it is impossible to doubt, a large section of Americans actually proposed to make their Government the virtual holders of the concession. Even the Senate showed itself by no means unfriendly to the proposed "deal," which was to cost the country some £24,000,000; but the House of Representatives, guided by a report of its Committee on Commerce, to which reference has already been made, rejected it *in toto*. "The Maritime Company," stated this report,

> Is a creature of the Government. The Government proposes, by the Senate Bill, to inject itself into the corporation, and, thus masquerading, to do a work that it is in every way capable of doing in its own proper person. For what purpose? . . . After the United States has paid the Maritime Canal Company 5,000,000 dols. for a conveyance of its rights, will it by force attempt to coerce reluctant and protesting Nicaragua to recognise its purchased rights, in face of the notice, ample and complete, that it must confess to the world it had, that the Maritime Canal Company has solemnly bound itself it would not sell to us, and that we knew it could not sell to us? . . . The term of ten years—granted to the company by Article 48 "for the construction, completion, and opening of the canal for maritime navigation"—expires on the 9th of October, 1899. It is claimed, however, that, under the last clause of the article, the company would have the right to demand further time, because of "the great capital the company has invested in the enterprise." This Committee has made diligent inquiry, striving to ascertain the amount of money the company has expended. The efforts have not been very satisfactory in results. Nothing more definite has been learned than the statement of the president of the company that the company has had in its treasury during its entire existence about 1,009,000 dols. . . . But what does the Government obtain from the company that it should pay it 5,000,000 dols.? What has the company to sell? What is an expired concession worth that originally cost 100,000 dols.? If the Government should initiate its effort to secure this canal by payments as provided in the Senate Bill, do we not thereby open the door to the demands of . . . and all the other enterprising and speculative persons, artificial and natural, that have been toying with canal concessions with more or less activity during the last half century?

The last sentence was obviously aimed at the Eyre-Cragin Syndicate, which, in October, 1898, obtained from the Legislature of Nicaragua a concession to construct a canal across the territory of the Republic, to take effect from the following October, when the grant to Mr. Menocal would legally be forfeited. This remained the only effective concession of its kind until September of the present year, when it in its turn was declared void by reason of the holders' neglect to pay over to the Nicaraguan Government a certain stipulated amount.

A LARGE BRONZE FORGING.

What is perhaps the heaviest bronze forging ever made is a Bull's metal ram, supplied to Vickers, Sons, and Maxim, Limited, Sheffield. The forged dimensions were 9⅝ diameter by 18ft. 6in. long. The forging weighed 2¼ tons. The test results were excellent. They are given in the following table:—

Number.	Dia. of test bar.	Area, sq. in.	Maximum stress, tons per sq. in.	Elongation on 4in.	Contraction on original area.
				Per cent.	Per cent.
3633	·818	·525	29·5	32·2	28·7
3634	·816	·522	29·0	33·5	28·3

Remarks.—A bar of 1in. diameter bent cold to 1¼in. radius without sign of fracture.

The shaft was made by Bull's Metal and Melloid Company, Limited, 4, St. Mary-axe, London, E.C.

The Inchdoune and Inchmarlow.—In the description of the superheaters fitted to these ships, it was inadvertently stated that the Ellis and Eave fans forced air into the stokehold, whereas they are exhaust fans drawing the air from the furnaces through the boiler and air-heating tubes. For this reason the above system is specially suitable for use with a superheating arrangement as fitted in the Inchmarlow, as no back pressure is thrown upon the furnaces as would be the case were forced draught used, due to the additional obstruction of the superheater in the uptake.

HOLDERS AT THE BIRMINGHAM GASWORKS.

No. II.

The gasholder, as erected in 1876, consisted of two lifts, 195ft. and 197ft. 6in. in diameter respectively, and both 36ft. deep. Its capacity was about two millions of cubic feet. The work of enlargement consisted in the addition of two new lifts to the bell, and the extension and strengthening of the existing guide framing. The latter comprised twenty-two circular cast iron columns, in tiers, connected by two rows of wrought iron girders. The columns were retained in position for the extended guide framing. The top cap and entablature were removed from each column and re-erected on the top portion of a new length of column. These new lengths were similar to the original upper lengths, being of cast iron, 3ft. in diameter at bottom, tapering to 2ft. 8in. at top, of ⅞in. metal, the flanges 1¼in. thick. The new lengths were about 36ft. 9in. in height. The old wrought iron top girders, which were 3ft. 6in. deep, were taken down and strengthened by the addition of a new steel flange plate, 21in. wide by $\frac{15}{16}$in. thick, to the outer edge of which a steel angle, 2½in. by 2½in. by ⅝in., was riveted. Each girder was stiffened by two pairs of vertical stiffeners of channel, 4in. by 3in. by ½in., kneed and riveted to the underside of the top flange and through the angles of the girder. The old top girders, thus strengthened, were used for the top tier. Joint plates, 2ft. 9in. long and ⅝in. thick, of the same width as the top and bottom plates of these girders, were riveted to them, and the opening through the side of the old column entablature—which was erected on top of the new length of column—was chipped larger in order to allow the new 21in. flange plate to pass through. New entablatures and girders were provided for the middle tier, *i.e.*, for the tops of the old columns. These girders were steel lattice girders, 3ft. 3in. deep, formed of four angles, 4½in. by 4½in. by ½in., flange plates 10in. by ⅝in., lattices 4in. by ⅜in., with centre plates 12in. in diameter, ⅜in. thick, at the intersection of the lattices on the front side of the girders. The girders were secured to the new entablature, octagonal in form and 3ft. across. Angle straps, 4in. by 4in. by $\frac{15}{16}$in., were bent to fit closely round thickened-out round seatings, formed on the new entablatures for their reception—four of these straps to each girder end. The old lower girders, which were left in position, similarly had four such straps secured to the old square entablature. The girders were thus formed into a strong continuous ring, which embraced the columns, whereas previously the girders had merely entered and been attached to the latter. The framing was, by the strengthening of the girders and the addition of the straps, converted to the modern cylindrical form, which is that best adapted to resist distortion. The transmission of the strains from one column to another was furthermore provided for by the insertion of diagonal ties in each bay or panel of the framing. These ties were steel channels, 6in. by 3in. by ⅜in. for the lower tier, and diminishing to 4½in. by 2in. by $\frac{7}{16}$in. for the top tier. They were riveted to ½in. centre plates and secured by double-angle plates to the girders, or, in the lower tier, to the base of the columns. The old channel iron guides, attached by brackets to the old columns, were taken down; the brackets were lengthened by cast iron blocks, and six new cast steel brackets were fixed to the shaft of the new portion of each column. A new steel joist guide, 6in. by 5in. by 28 lb. per foot, was provided and fixed up the whole height of the columns, being bolted to each bracket. The joints of the guides were fished on the back side with channel-shaped joint covers, 1ft. 9in. long by ⅜in. thick. A bell-mouthed trough steel casting was fixed to the cap of each column as a continuation of the guide.

The old framing was thus greatly strengthened and its height increased by about one-half. The old two-lift bell, however, was converted to a four-lift belt, thus being doubled in height. When, therefore, the gasholder was full the new inner, or first, lift was designed to rise above the guide-framing. This system of leaving the inner lift—and in some instances the second lift also—unsupported by guide framing, was first proposed by Mr. Livesey and applied by him in 1887 at Rotherhithe, and subsequently in the large gasholder at East Greenwich. The system effects a great saving in the cost of the guide framing, owing to the reduction of its height below that of the bell, but the bell becomes a slightly more costly structure owing to greater stiffness being essential in the inner lift. Mr. Hack has carried the guide framing in both the extended No. 5 holder and the new No. 6 holder, of which we shall speak shortly, only to a height suitable for the top rollers of the second lift. The cup of the inner lift, therefore, does not rise above the top of the framing. The top rollers of the inner lift, when it descends from above the framing, pass into the bell-mouthed trough on the tops of the columns, and are thereby directed to the guide run on the columns. Safe working, when the inner lift has been run out and the holder is descending, is thus assured, as the top rollers cannot fail to find their guides.

The old outer lift of the holder was not altered, except that each alternate stay of the forty-four inside vertical stays riveted to the sides of the lift was strengthened by riveting to its back an 8in. bulb tee, which was also secured to the bottom curb by angle plates and bolts. The dip of this lift was deepened from 18in. to 21in. by riveting to its lower edge a new steel bulb. The old inner lift, after removal of its top curb and the crown, was provided with a dip and utilised as the third lift of the enlarged holder. The old joist iron vertical stays were removed from it, and forty-four new vertical stays, each composed of a channel 6in. by 3in. by ¼in. thick, and flanges $\frac{7}{16}$in. thick, and two angles 3in. by 3in. by ⅜in., riveted to the former and to the sides, were introduced. To these stays were riveted forty-four outside stays of bent plate 3in. deep. This lift, when altered, was 36½ft. deep. The new second lift consisted of first rows of plates 2ft. deep, ¼in. thick, adjoining cup and dip; second rows from cup and dip 2ft. $7\frac{5}{16}$in. deep, 0·176in. thick; and nine intermediate rows about 2ft. 7in. deep and ⅛in. thick. It was provided with forty-four vertical stays of channel 7in. by 3in. by ½in., to each of which were riveted angles 3½in. by 3in. by ⅜in. These stays were riveted to the side sheets and outside stays of bent plate 4in. deep, and formed guides for the radial and tangential rollers of the inner lift. The diameter of this second lift was 192ft. 6in. and its depth 36½ft. The inner lift was the same depth, and 190ft. in diameter. The crown of the old inner lift, after taking out the four outer rows of sheets, was used in the crown of the new inner lift. The crown was untrussed and rose 10ft. in the centre. It was required to be, when altered, a true segment of a circle. The top curb of the lift was formed by three steel rings of angles, one 6in. by 6in. by ⅝in., open to an angle to suit the rise of the crown; one 5in. by 3½in. by ⅜in. on the side plates; and one 6in. by 4in. by ⅜in. on the crown plates. The ends were machine cold sawn so as to butt exactly, and the joint covers were 3ft. long and the full strength of the angles. The outer ring of the crown was made of new sheets, ⅜in. thick and 3ft. 7in. wide, with butt joints and double joint cover plates. The second row was new ½in. sheets, about 2ft. 6in. wide, while the third and fourth rows were the second and third rows of the old crown cut and altered to suit. The top row of side plates was of ⅜in. steel, 2ft. deep, with butt joints and double joint covers as in the outer row of crown plates. The second row from the top curb was 2ft. 4in. deep, of $\frac{5}{16}$in. plates, while the third row and the second row from the top of the cup were 2ft. 6⅛in. deep, and 0·176in. thick. The row next the cup was 2ft. 3in. deep and ¼in. thick. There were nine intermediate rows between the third from the top curb and the second from the cup, each about 2ft. 6⅛in. deep and ¼in. thick. Twenty-two vertical stays and gusset plates removed from the old inner lift were re-fixed in the new inner lift, and twenty-two new vertical stays, composed of plates bent to semi-circular form, 11in. wide by 15in. deep, with side flanges, were fixed opposite the columns. To these were riveted twenty-two new gusset brackets, composed of two ¼in. plates 4ft. 6in. long, one riveted to each side of the vertical stays, and having their edges stiffened by a 3in. by 3in. by ⅜in. angle, and riveted on top to the outer row of crown plates and the inner angle curb ring. The gussets were braced together on the inner edge by two pairs of lattices. Forty-four new intermediate gussets were fixed between the stays, formed of one ⅜in. plate, and two 3in. by 3in. by ⅜in. angles. These particulars will show, without further details, that the new inner lift was made unusually stiff in order to resist the forces tending to distort it when it runs out above the guide framing.

The two new pairs of cups and dips were of "Piggott" pattern, 21in. deep and 10in. wide, the edges finished with a bead 2½in. by ¾in. Wrought iron packing pieces, 1½in. deep, and 6in. long, were secured, one to each plate, to the dips by bolts with countersunk heads and nuts outside.

Each lift was provided with twenty-two top roller carriages. Those on the inner lift were of ½in. side plates, 4in. by 4in. by ½in. angles, and ½in. top and bottom plates. They were fitted with the 24in. diameter rollers which had formerly been used on the old inner lift. The carriages on the second lift were each fitted with two tangential rollers, besides a radial roller 18in. in diameter. Lateral stiffness was given to these carriages by angles, 6in. by 3in. by ½in., bolted to the dip and about 7ft. 6in. on each side of the radial carriage. The third lift had only radial top rollers, 16in. in diameter, while the top carriages of the outer lift were fitted with the rollers, 13½in. in diameter, which had been removed from the old top carriages of this lift. The top carriages were new throughout. The new rollers were of chilled cast iron, turned on face and sides. All the spindles were placed in slotted holes so as to be capable of adjustment. The inner lift was provided with forty-four sets of carriages and cup rollers, each set comprising two tangential rollers and one radial roller, fitted in carriages attached to the back of the vertical stays with a plate ½in. thick. The second lift was provided with forty-four sets of carriages and radial cup rollers, with back plates for attachment to the cup and vertical stay. The old cup rollers and carriages on the third lift—formerly the inner lift—were retained.

It only remains to add that the twenty-two radial timbers of the framing in the tank had to be shortened to suit the diminished diameter of the inner lift. The particulars given above afford an idea of the amount of work involved in the addition of new lifts to a large gasholder. From an engineering standpoint an undertaking of this kind presents as great difficulties as the design of a new gasholder of equal capacity. The extension of the No. 5 gasholder at Saltley was carried out according to Mr. Hack's specification and drawings by the contractors, Westwood and Wrights, of Brierley Hill. Mild steel, capable of sustaining a tensile strain of 30 tons, with not less than 20 per cent.—rivets and bolts 25 per cent.—of elongation was used for the work, with the exception of the new lengths of columns, which were of cast iron, like the original columns. The pressures thrown by the extended holder were as follows: First lift, 4·2in. (of water); second lift, 6·6in.; third lift, 8·6in.; and fourth lift, 10·3in. The cost of the extension amounted to rather less than £16,000, and as it provided an addition to the capacity of the holder of two million cubic feet, the cost per million cubic feet storage gained worked out at rather less than £8000. This was less than half the cost per million cubic feet by the original holder, in which, of course, there was the cost of the tank to be included. Clearly, therefore, a skilfully planned extension of an existing holder affords a means of obtaining additional storage accommodation at a very cheap rate, more especially on unfavourable sites, such as at Saltley, where tank construction becomes a very costly item.

The foregoing account of the extension of an existing holder has aptly illustrated the changes in gasholder construction introduced since 1876, when it was originally fihished. The new gasholder, completed at Saltley in November last year, presents an excellent example of the best

modern practice in constructive work of this class. The only holder in the world of greater capacity than this latest design by Mr. Hack is that at East Greenwich, to which we have already referred. But as we have pointed out, the East Greenwich holder is of peculiar proportions, which would not have been adopted under reasonably favourable conditions as to site. Other large gasholders, which are of only slightly smaller capacity than Mr. Hack's new one, are a four-lift holder at East Greenwich, one at Beckton, and one at Kensal Green—all in connection with the supply of gas to the metropolis. The four-lift holder at East Greenwich was, like the six-lift holder there of which we have already spoken, designed by Mr. George Livesey. The tank is slightly over 250ft. in diameter, and 44ft. deep, and the capacity of the holder is eight millions of cubic feet. The guide framing extends to the full height of the holder, which in this respect differs from the six-lift holder alongside it. The dimensions of the four-lift gasholder at Beckton are nearly the same, and its capacity also is eight millions of cubic feet. It and the rather smaller holder at Kensal Green were designed by Mr. G. C. Trewby, M. Inst. C.E., the engineer to the Gas Light and Coke Company. In both the guide framing extends to the full height of the gasholder. Mr. Hack's new holder, however, like the extended No. 5 holder at Saltley, of which we have given particulars, has one of its four lifts running out above the guide framing. Its design would seem to comprise all the good features of other large modern holders, while certain peculiarities introduced in some of them, for sufficient but special reasons, are avoided. Having regard to the admirable

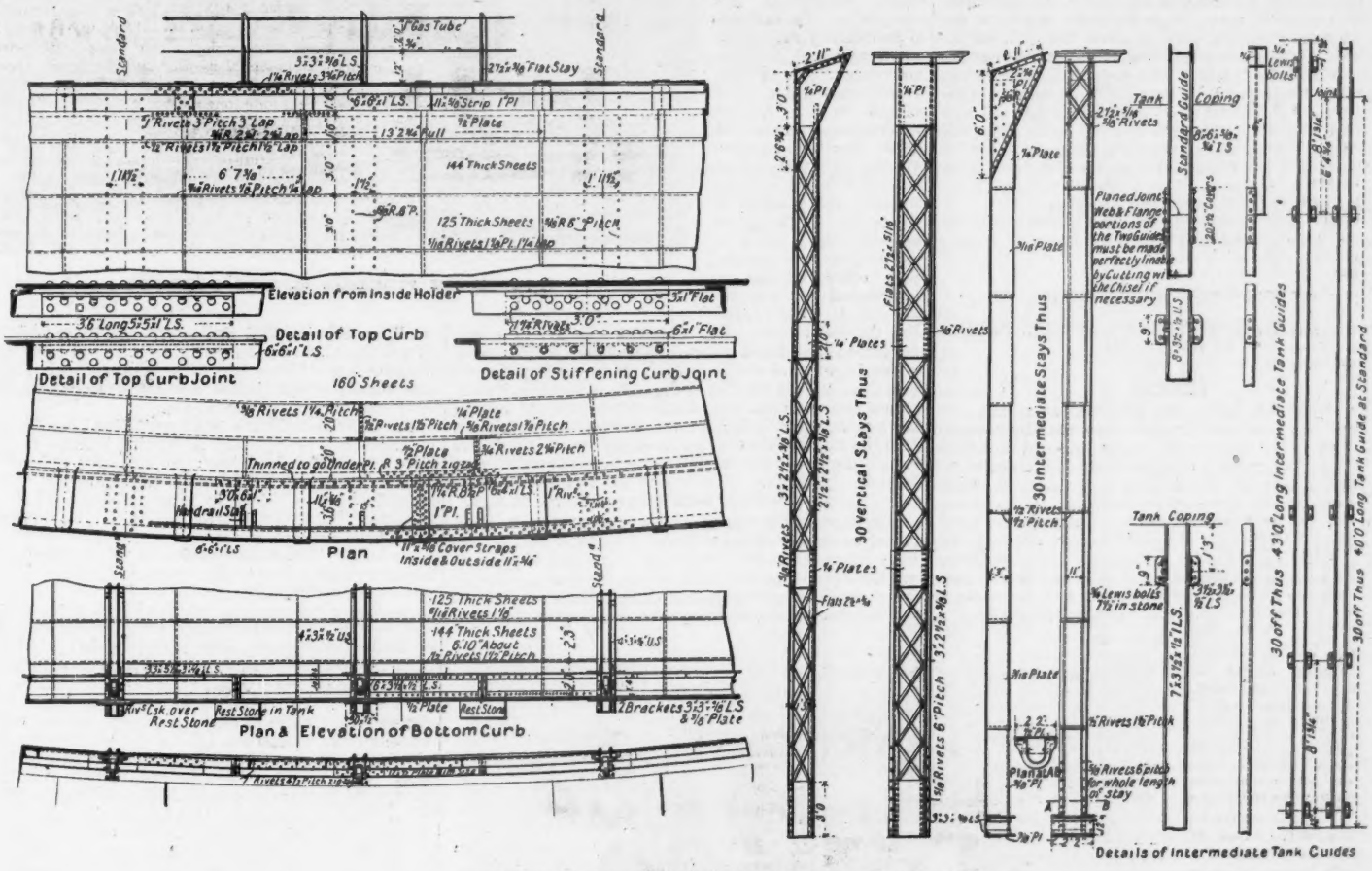
First (inner) lift	... 252ft. 9in. dia., 41ft. deep to underside of cup	
Second ,,	... 255ft. 6in. dia., 42ft. ,, ,,	
Third ,,	... 258ft. 3in. dia., 41ft. 9in. ,, ,,	
Fourth (outer) lift	... 261ft. 0in. dia., 41ft. 6in. ,, ,,	curb

The tank guides are thirty steel channels 40ft. long, 8in. by 3½in. by ½in., for attachment to the guides on the standards, and thirty steel channels, 48ft. long, 7in. by 3½in. by ½in., placed intermediately. Each guide is in one length and provided with angle lugs for securing it by four coach screws to the oak blocks in the tank wall. The top ends of the intermediate guides are fixed to the stones by Lewis bolts run with best Portland cement. Any space behind the guides after they had been fixed plumb was filled by grouting with neat Portland cement, thus rendering them solid at the back throughout.

The crown of the inner lift of the holder consists of an outer ring of plates 1in. thick, with butt joints and double ⅜in. and ⅝in. cover plates; second ring, ½in. thick; third, ½in.; fourth, 0·160in.; and others, 0·144in. thick; all arranged on the herring-bone system. Inner edges of the ring plates are straight, but the outer edges are cut to circular form. The crown curb consists of a ring of 6in. by 6in. by 1in. angle steel, rolled to the angle which suits the curve of the crown, and double riveted to the crown and side plates. A ring of 6in. by 4in. by 1in. angle steel is riveted to the inner edge of the 1in. plates. The angle curbs are joined by cover plates of steel 3ft. 6in. long and 3ft. long respectively. The top row of side sheeting is 1in. thick, with butt joints and double ⅝in. cover plates, the second row ½in. thick, the third row and row next cup 0·144in. thick, and ten intermediate rows ½in. thick. There are thirty "box" vertical lift are similar to those of the second lift, but the sixty vertical guides for the cup rollers of the second lift are composed of 6in. by 3in. by ½in. channel and two angles 3in. by 3in. by ½in.

The sheets adjoining the dip and bottom row of plates of the fourth lift are 0·144in. thick; the bottom row is ⅝in. thick, and the eleven intermediate rows are 0·116in. thick. The vertical guides and outside stays are as in the third lift, except that the channels for the stays are 4in. by 2½in. by ½in. The bottom curb of this lift consists of two angles 6in. by 3½in. by ½in., and 12½in. by ½in. plate; the inside edge curved to the radius of the outer lift, and the joints opposite the vertical stays. The joint covers are of angles 3ft. 3in. long. The vertical guides are attached to the bottom curb by box brackets of ⅝in. plate. There are sixty curb stiffeners of ⅜in. plate. The top angle of the curb is attached to the vertical stays by flat clips 3in. by ½in. The drawings give further details of the cups, dips, and curbs of the holder.

All the rollers are of cast steel, turned on the cheeks and on the rims. The rims are slightly curved, and the holes for pins are bored 1/16in. larger than the pins. The pins are of steel. Rectangular slotted holes are provided for adjustment with steel packing. Each lift has thirty carriages, constructed of plates and angles of the sizes and thicknesses shown in the supplement. The top carriages of the inner and outer lifts are fitted with one radial roller only 20in. and 14in. diameter respectively. The top carriages of the second lift have each one radial roller 20in. in diameter, and two tangential rollers 18in. in diameter.



SALTLEY GASHOLDER—CURBS AND VERTICAL STAYS

design of this unique monument of Mr. Hack's engineering skill, we are very glad to be able to give prints taken from the working drawings, and full particulars drawn from the specifications for the work.

The site chosen for the holder was at a short distance from the No. 5 gasholder, of which the work of extension was in progress during the construction of the tank for the new, No. 6, holder. In view of the proximity of the two tanks and the fact that the ground is sand and ballast abounding in water, it was decided to make the bottom of the new tank at the same level as that of the old one, and to secure a slightly increased depth by carrying the walls of the new tank slightly above the original average ground level, which was raised where necessary. The new tank, after all settling, compression, and contraction had taken place, formed, as required by the specification, a true circle throughout of 264ft. internal diameter, measured from face to face of the cement rendering, and 42ft. deep at sides from top of resting stones to top of coping. The top of the coping is 5ft. above the top of the tank of No. 5 holder.

We shall give particulars of the construction of the tank in considerably greater detail than we propose to give of the gasholder itself, because our remarks on the extensions of the No. 5 holder will on many points apply to Mr. Hack's new holder. Moreover, the copies of the working drawings which we give as supplement render a detailed description superfluous. There are, however, a few matters to which attention should be drawn here.

The gasholder when cupped rises to a total height of 160ft. 5in., and the rise of the crown is 22ft. in the centre, and is in the form of a true segment of a sphere. The following are the dimensions of the lifts.

stays opposite the standards, each composed of two angles 3in. by 2½in. by ⅜in., and two angles 2½in. by 2½in. by ⅜in., with ½in. plates, and lattices as shown in the drawings above, forming a box stay 15in. by 20in. There are also thirty bent plate intermediate vertical stays, 11in. wide by 15in. deep, with 3in. flanges for riveting to the sides of holder. The top plate is ½in., the bottom ⅜in., and the five intermediate plates of each stay 5/16in. thick. Both these and the box stays are widened out at the top to reach the inner curb angle, as shown in the drawings. Three manholes are provided in the crown, 36in. in diameter. Two are fixed over the inlet and outlet pipes. There is also a light handrail round the edge of the crown.

All the cups and dips are Piggott pattern, 21in. deep and 10in. wide inside, with a convex bar 3in. by ½in., riveted to the edges of the plate. The cup and dip plates have lap joints 2½in. wide. All the dips have wrought iron packing pieces 1½in. deep, 6in. long, secured by two ½in. rivets, one in centre of each plate. All cup and dip plates are of 24in. minimum depth on the gasholder side, and their thickness is ½in. on inner, 7/16in. on second, and ⅜in. on third and fourth lifts.

The side sheets of the second lift adjoining the cup and dip are 0·144in. thick, and of equal widths; there are eleven intermediate rows 0·116in. thick. There are sixty vertical guides for the tangential and radial cup rollers of the inner lift, composed of 7in. by 3in. by ½in. channel, and two angles 3½in. by 3in. by ⅜in., riveted together by ⅝in. countersunk rivets 6in. pitch. There are also sixty outside vertical stays, composed of two channels, 3in. by 3in. by ½in., bolted to the side sheets and to the angles of the vertical guides by ⅝in. bolts.

The side sheets and outside vertical stays of the third

The third lift has radial and tangential rollers, all 16in. in diameter. Sixty sets of cup rollers are fitted on the inner lift, each set consisting of one radial and two tangential rollers, all 9in. in diameter, fixed in flanged steel carriages ½in. thick, bolted to the cup and to the backs of the vertical guides, with ½in. plate between. The second and third lifts each have sixty radial rollers, 9in. in diameter, fixed in ½in. flanged steel carriages. The outer lift has sixty rollers, 14in. in diameter, fixed in ½in. flanged steel carriages bolted to the angles and side plate of the bottom curb, with ½in. packing plates at back. The construction of, and method of fixing, all the carriages will be seen from the drawings.

The guide framing comprises thirty steel standards, 5ft. 4in. wide at bottom, curved in to 3ft. wide at a vertical height of 4ft. 9in. from base, and tapering up to 2ft. at top. They are constructed of angles of various sizes and thicknesses, and ⅜in. thick web plates. The front plate is 1ft. 10in. wide at top, and tapers down to 2ft. wide near the bottom, and thence to 4ft. 6in. wide at base, and is ½in. thick. The back plate is 12in. wide at top, and at 5ft. 6in. above bottom, tapering to 4ft. 6in. wide at bottom, all ½in. thick. At five equidistant points on the back of the standard there are riveted ½in. joggled wing plates, with ½in. joggled cover plates inside the flange, and at corresponding places on the front flange there are fixed similar joggled plates, and at the base gusset plates, to which the diagonal ties of the framing are riveted. Cast iron washers for the rivets are placed between these plates. The base-plate is ⅜in. thick, with ⅝in. washer plates. Tees, 5in. by 5in. by ½in. are riveted to the base-plates for the attachment of the gusset plates for the ties. The joints of the web of the standard are covered by ½in.

plates each side, and the standard is stiffened at intermediate points on each side of the web by brackets composed of two angles, 3in. by 3in. by ½in., and ½in. plate. The front guide rail is formed of steel joists, 8in. by 6in. by ¾in. web and ⅝in. thick flanges, with butt joints having cover plates on inside. The joist guides are attached to the standards by two continuous angles, 3½in. by 3½in. by ½in., riveted to the guides and to standards. All the riveting to the standards and guides is with ¾in. rivets, 4½in. pitch, countersunk on the faces of the guides. A bell-mouthed steel casting is fixed to the top of each standard for the purpose of directing the rollers of the inner lift on to the guide rails when it descends from above the guide framing. There are five tiers of double ties, constructed of flat bars, one set fastened to the back, the other set to the front flange of the standard. The ties increase in width from 5in. for the top tier to 9in. for the bottom tier; all are ⅝in. thick. The ends are riveted to the ½in. wing plates on the flanges of the standards. Each pair of ties is provided with cast iron distance ferrules of suitable length for the particular bay of the framing, and through bolts with nuts and washers. The ties when fixed were quite taut and lineable.

There are five tiers of girders, each formed of steel pile section, each section being exactly a quarter of a circle, with a radius of 4¾in. The four sections in contact form a circle 9½in. diameter inside. The flanges are 3in. wide and ½in. thick, and the web is $\frac{7}{16}$in. thick. The girders have 6in. by ⅜in. bulb bars fixed between the flanges of the pile sections. The top girder has an additional bulb bar, also a plate 17½in. by $\frac{5}{16}$in., widened out behind the standards with a continuous steel angle, 3in. by 3in. by ½in., supported by a bracket on the back of the standards. On this horizontal plate, angle handrail standards are fixed for tube handrails passing round the back of the standards. The rivets used throughout the girders are ¾in. diameter, 4½in. pitch. The ends of all the girders are provided with flanged plates, ½in. thick, secured to the standards and girders by rivets passing through the web and joint plates of standards and the web of the pile respectively. The top girders have stiffeners about 7ft. apart formed of ½in. plate and bent tees 5in. by 2½in. by ½in., with ½in. packings. The details of the standards, ties, and girders are shown in the drawings.

A steel ladder is fixed to the ties in one bay of the framing, from ground line to top girder, with landing stages on each girder.

ELECTRICAL ENGINEERING AT THE PARIS EXHIBITION.

No. VIII.

GRAMME.

The electrical industry has developed so rapidly, and the front rank has been superseded so often by youmger men, that we are accustomed to new men and new firms every few years; and a business that has been going on for several years is almost by common consent looked upon as old, and to some extent obsolete. It is curious, however, that the very first concerns, namely, the introducers of the Gramme and drum armatures, are still not only in existence, but in the first rank. Though Siemens and Halske were not the inventors of the drum armature, they certainly made it commercially; and the same is true of the Gramme armatures. It is quite refreshing to realise that the Société Gramme, having attained its majority, shows as much vitality as ever. It is hardly necessary to remark that this company exhibited Gramme machines. There were thirteen single magnetic circuit Gramme machines from ½ horse-power to 54 horse-power. But in large size multipolar work the drum winding was adopted. In this type the power rises to 500 kilowatts. The 500-kilowatts machine had twelve poles, and is of the type that was practically universal on the Continent.

Fig. 1 shows a Gramme machine for electrolytic work. This type is made in stock patterns up to 5 and 7 volts and 1500 amperes; larger sizes are, of course, made to order. The Société Gramme also exhibited alternators and triphase machines. It showed a 300 horse-power triphase machine giving 220 kilowatts at 600 revolutions and 50 periods per second. One of the most interesting of this firm's exhibits was a small set, consisting of an oil motor and dynamo coupled on one bed-plate. This is shown in Fig. 2. The little oil engine has water circulation. It drives a small 4-pole dynamo giving 18 ampères and 110 volts for thirty lamps. This firm also showed a large number of small meters combined with tools of various sorts, such as milling machines, drills, &c. The Société Gramme was one of the few who exhibited enclosed arc lamps.

Fig 1—GRAMME PLATING MACHINE

PARSONS.

In the English section were to be seen two Parsons steam turbo dynamos, each of which was a distinct type of combined plant, and each had an interest of its own. The turbine is now so well known that only the barest description of its action is necessary. It really consists of a series of turbines, in which are set the guide and moving blades. The turbines are all cast in one, and are directly connected in such a manner that the steam is free to pass from the high-pressure end to the exhaust, expanding regularly as it passes from each ring of blades to the next. By these means the walls of the turbine are kept at constant temperature, which gradually diminishes as the exhaust is approached; thus cylinder condensation is greatly eliminated, and when lagging is resorted to it is reduced to a minimum.

The manner of governing the turbine may not be quite so familiar, and its action, briefly described, is as follows:—The steam enters through a double-beat valve, which is kept constantly opening and closing by means of a steam relay actuated by the turbine shaft through the medium of worm gearing; thus steam is admitted in gusts, the duration of which is varied by the governor. A long lever extends the whole length of the turbine, at one end of which is secured a core controlled by a solenoid in shunt with the main field. At about seven-eighths of the rod is placed the fulcrum, while at the short end is the relay valve, controlling the main valve. The fulcrum is periodically moved up and down; each of these movements opens the double-beat valve and admits steam. As the load increases the solenoid draws the lever up, thus altering the position of the relay valve and increasing the duration of the gusts. In the case of an alternator, which is required to run in parallel with other engines, a mechanical governor can be fitted which keeps the turbine running at a constant speed. A safety governor is also fitted in case any accident should occur, which is governed mechanically. It is needless to add that this is merely fitted as a safeguard, and seldom, if ever, comes into use, since the electrical governor will control the machine should there be a short circuit on the mains, or if the machine should lose its excitation. So sensitive is this governor, that full load, or even an overload, may be suddenly thrown off or on to the machine without making more than 2 per cent. difference in the voltage.

The larger of the two machines is a 500-kilowatt alternator, which is designed to run at a speed of 2400 revolutions per minute with a frequency of 80, and to generate at 2400 volts—page 609. The turbine shaft at its extreme end carries a worm engaging in a worm wheel which drives the mechanical and main governors. Also on the worm wheel shaft is placed a crank driving the oil pump which delivers oil to all the bearings under a pressure of about 5 lb. per square inch. As all the keeps are enclosed no oil is wasted, but all returns to a well from which the pump draws its supply. At the other end of the turbine shaft is a coupling which drives the main armature. This is hole wound, with casings over the end connections, thus protecting the cable from all mechanical injury, and at one end are placed brass collecting rings, from which the current is collected by brushes held in the Parsons gravity type of brush holder. The advantage of these holders is that the pressure of the brush is adjusted once and for all, therefore no chance is given for an unskilled attendant to increase the pressure and score the rings. On to the main armature is also direct coupled the exciter armature, the breadth of the plant being thus kept within small limits. The bearings throughout are of the Parsons tubular type, any slight vibration being completely damped out by the films of oil between the sleeves. So smoothly do these machines run, that when one machine similar to this type was being tested, some water switches which were standing within a few feet of the dynamo had not even a ripple on them, even though the surface of the water presented a fairly large area; and the machine was just resting on baulks of timber.

In many cases these 500-kilowatt alternators have the condenser in a pit beneath the turbine and the pumps driven off the end of the shaft by worm gearing. The steam consumption of a turbo alternator similar to this one was 22·5 lb. per kilowatt hour at 598 kilowatts output, with a vacuum of 24¾in., and a boiler pressure of 180 lb., and at 256 kilowatts output the consumption was 27·5 lb. The floor space taken up is 25ft. by 6ft. 4in., which is very small, considering that the output can be exceeded by 20 per cent., while the machine has been run up to 750 kilowatts. The weight is 18 tons, and the machine rests merely on wood blocks, without needing any holding-down bolts or special foundations.

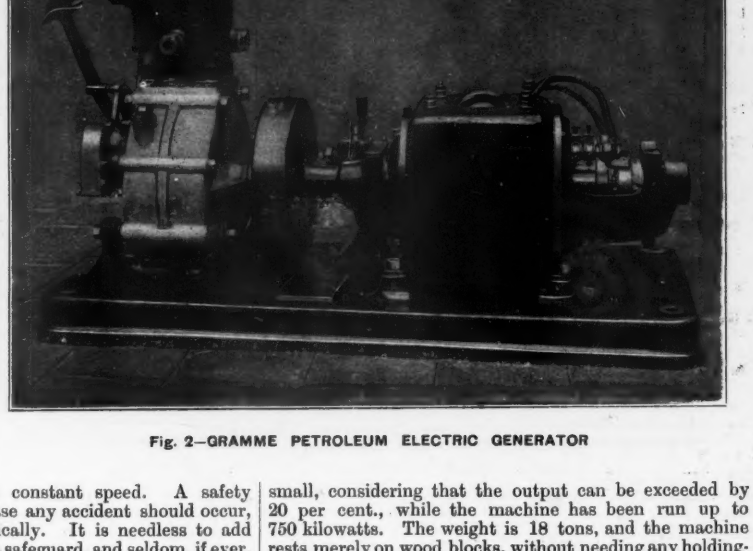


Fig. 2—GRAMME PETROLEUM ELECTRIC GENERATOR

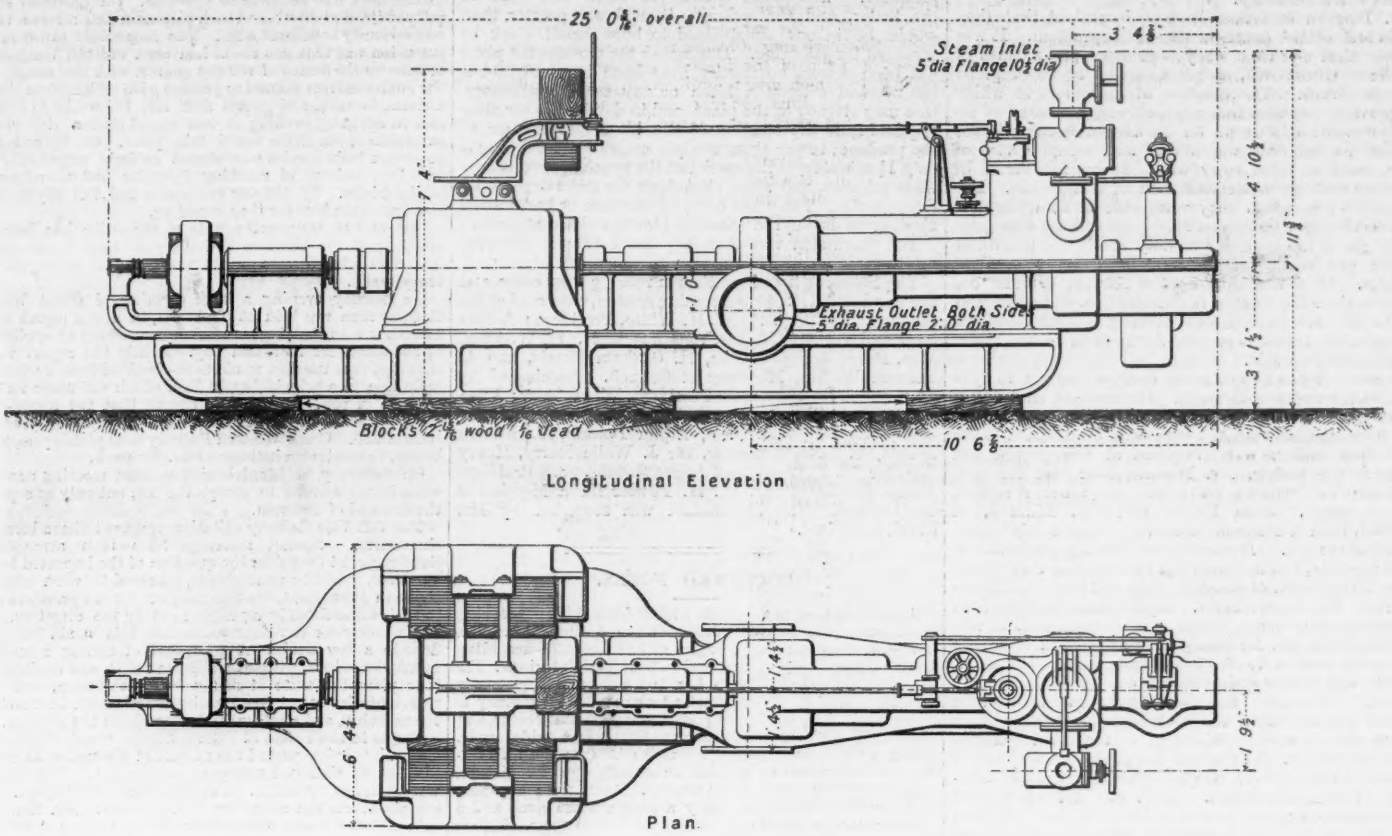
The other machine is a 50-kilowatt direct-current turbo generator, and is especially interesting because the bed-plate is also the condenser; in fact, the turbine and dynamo are simply bolted on to the condenser, and the pumps, which are driven by worm gearing, are bolted to the side. The condenser itself merely rests on the engine-room floor without any special foundations or holding-down bolts. Such a combination as this is only possible with a turbine, owing to the absence of vibration or any strains set up by a reciprocating motion, and moreover it forms a most compact and efficient plant. The machine has been run up to 70 kilowatts, when it consumed 33 lb. of steam per kilowatt hour, including that required to drive the pumps. The speed was 3500 revolutions per minute, the boiler pressure 120 lb., and the vacuum 25in. of mercury. The coupling between the turbine and dynamo has a worm formed on it, which drives the worm wheel for the pumps and governing gear, also the small oil pump. The machine is governed electrically in the same manner as has been described further back, and though the dynamo is shunt-wound, the volts do not fall off as the load increases. It is possible to compound the electrical governor with the utmost ease, and in some cases the governor of the alternator is compound-wound, as could be seen on the 500-kilowatt at the Exhibition. The dynamo of the 50-kilowatt plant has a surface-wound armature, while the commutator is held together by heavy steel rings, and the magnets are of the usual bipolar horseshoe type. Many machines of this type have been made both for lighting and traction, direct current and alternating, up to 250 kilowatts output, and are running successfully. For ship lighting it is a suitable plant, since a separate condensing engine and condenser are not needed, nor need the main condenser be used; the amount of space and weight saved is, therefore, considerable. Above 250 kilowatts output it is the usual practice to place the condenser in a pit beneath the turbine, though the pumps are still driven as before; but above 500 kilowatts it is advisable to have a separate engine to drive the condenser pump.

Dynamos are not the only machines turbines are capable of driving, and they have been successfully applied to centrifugal pumps, fans, and any such class of work. One fan recently supplied to a colliery was 6ft. diameter, and delivered 200,000 cubic feet of air per minute at 3in. water gauge; and a centrifugal pump, lately made, delivered 850 gallons of water per minute with 160ft. lift.

The Turbinia could also have been seen at the Exhibition moored in the Seine, and at the present moment she is especially interesting as being the prototype of the Viper, which recently steamed at over 37 knots.

The fact that no oil enters the turbine cylinder gives this type of machine a great advantage over the reciprocating engine, since the exhaust steam is quite clean, and if condensed may be put straight back into the boilers; also superheating may be indulged in to a much greater extent than with the reciprocating engine, since there are no glands to score, and there is no oil in the cylinder to carbonise and so choke it up. Even moderate

500-KILOWATT PARSONS TURBO-ALTERNATOR



superheating increases the efficiency of the turbine 8 to 10 per cent. For traction and power purposes the turbine is pre-eminently suitable, since there is no objection on the machine's part to moderate overloading, and it picks up the load instantaneously. This is very much opposed to the doctrines of the upholders of slow-speed engines and heavy fly-wheels; and yet the popularity of the turbine for this class of work shows it is a genuine success, and not a mere scheme, and besides, a turbo-dynamo takes up very much less space than the slow-speed or even high-speed reciprocating engine. At Blackpool there are nothing but turbo-dynamos for running the trams, and there are machines on hand now for other lines also.

INSTITUTION OF MECHANICAL ENGINEERS.

AFTER the transaction of a little business at the Institution of Mechanical Engineers on Friday evening last, a paper, written by Mr. Herbert A. Humphrey, was read in abstract by the secretary. We commence the reprint of this paper in an abbreviated form in another place. It was entitled "Power, Gas, and large Gas Engines for Central Stations." This title was, in a measure, delusive. Its main justification is to be found in the numerous tabulated results of trials embodied in several appendices. But the paper was principally devoted to an advocacy of the Mond producer. Mr. Humphrey, as everyone knows, is closely associated with Brunner, Mond, and Co., Limited. The work involved in the preparation of this paper has evidently been considerable, and of its value there can be no question. But we believe our readers will agree with us if we say that it would have been better had the treatment of a subject of such importance been entrusted to an independent writer.

After Sir William White, who occupied the chair, had expressed the thanks of the meeting, Mr. Humphrey was invited to add a few remarks to his paper. He said that any anxiety as to the correctness of the meter used in the engine tests recorded had now been removed by checking it against the rise and fall of a gasholder of known capacity. As regarded the thermal efficiencies recorded, he had taken the higher calorific value of the gas. If the lower heat value was taken, a difference of 10 per cent. would be made in favour of the engine. To the list of names of makers of gas engines of over 200 horse-power the name of the Campbell Gas Engine Company should be added. The efficiency of the Crossley engine mentioned in the paper had increased since it had been in the possession of Brunner, Mond, and Co. He then directed attention to diagrams and tables of tests of a Premier gas engine, which were not completed in time to embody in the paper, but were shown as a wall diagram. They marked, he said, a world's record for thermal efficiency attained with producer gas, and we had the remarkable result of obtaining one indicated horse-power hour for an expenditure of 0·88 lb. of cheap bituminous slack of so poor a quality that it only contains 62 per cent. of carbon. It was unfortunate that for the present he had no means of absorbing the full output of this large engine, but he felt quite justified in saying that when full load was reached a thermal efficiency of not less than 27 per cent. would be obtained as calculated on the brake horse-power and the lower calorific value of the Mond gas.

At the request of the President, Dr. Mond opened the discussion. He read his remarks. The substance of them was that although electricity was at present a very convenient method of transmitting power, power in the form of gas can also be transported over a great distance. "I may remind you," he read, "that in the United States natural gas is transported in immense volumes over more than a hundred miles, and distributed over very large districts. It is true this gas will yield per cubic foot about six times the power that my producer gas will yield; but this only means that either the mains would have to be rather more than double in diameter, or that the engines employed at certain intervals along these mains for propelling the gas through them should be increased in number and placed at shorter distances. Probably a medium course of increasing the mains to some extent, and decreasing the distance between the propelling engines, will be adopted. The transportation of energy in the form of gas has the advantage that the loss of energy by friction is less than the loss of energy by resistance in electrical transmission. The principal advance made in the use of power gas is the great increase in the size and power of the gas engines during the last few years, without which their application to large industries would have been impossible. Many gas engine builders in many countries have tackled this problem and have achieved success, and the tables in the paper show that England has not lagged behind other countries in this important movement; and that two of our gas engine builders, Crossley Brothers, of Openshaw, and the Premier Gas Engine Company, of Sandiacre, have turned out gas engines of 500 and 650 horse-power respectively, which are running with most satisfactory results. The thermal efficiency of these engines has also been improved, and in this respect also the engines built in England—and in particular the engines built by the Premier Gas Engine Company—have given results equal to the best results gained elsewhere. As the Premier engine during its trial was only working at two-thirds load, it will be apparent to any one conversant with the subject that it must at full load give a still higher efficiency, and prove superior in this respect to any gas engine the results of which have so far been published. It must not be forgotten that the large gas engines spoken of in this paper are really the first that have ever been made, and that in the nature of things the experience gained with them will and must lead to further improvements. One point, however, has been fully established already—there is no longer any limit to the size and power of gas engines, and any demand that may be made upon them can now be supplied."

Mr. Crossley was the next speaker. After expressing approval of the paper, he referred to the trials of the 400 horse-power engine made by his firm, the tests of which were reported in Appendix IV. He admitted that they, the makers, were disappointed that a higher efficiency had not been obtained. This was, he thought, to be ascribed to fluid friction, produced by the long suction pipe and the arrangements for filtration. Examination of the indicator card would show his point. For another thing, the engine was suffering from newness. Reference had been made to the fact that the compression was low. They had three reasons for keeping it down. First, the engine had to run with a heavy load continuously night day and for long periods. Secondly, the pistons were larger than they had ever dealt with before, and they did not know how the engine would behave; and, finally, they had an excellent supply of cheap gas to draw from, and however much they might have desired to establish a record, they considered it wiser to ensure perfect steadiness and trustworthiness. With their present experience they would certainly increase the pressure and so get a thermal efficiency of 30 per cent. out of large engines. With an engine having a 20in. piston they had already obtained 31½ per cent. of thermal efficiency. The author had commented on the large diameter of the shaft in Westinghouse gas engines. The reason why such large shafts were employed was because the engines were made for a compression of 140 lb. with a gas having thermal value 1000, which produces a very high pressure, possibly 600 lb. per square inch of piston. The maximum pressure calculated for in a Crossley engine is 400 lb. per square inch, using gas of 700 thermal value, with 140 lb. compression. He was glad to notice, however, that the thermal efficiency of the Westinghouse engine was only 24½. His firm was now endeavouring to meet the difficulty of fluid friction, to which reference had been made. The system of governing by wire-drawing the charge as adopted in America seems to him to greatly increase fluid resistance. He had patented various ways of cutting off the whole charge on the Corliss system, which, as far as experiments had gone, show good results. On this system the full area of the mixture valve is open under the control of the governor for any portion of the suction stroke, and then suddenly closed, thus allowing a slight vacuum to form during the remainder of the outward stroke, which aids the return stroke till the point of cut-off is reached. He thought this system would prove more economical in large engines than the hit-and-miss system; and he had no doubt it would be proved more economical than the wire-drawing method, because it keeps the admission valve wide open during admission. He agreed that sequence of rotation in the tandem engine was not all that could be desired, but the advantages of the type counterbalanced this objection, and it was a particularly good arrangement when two engines, and four cylinders, were employed. Speaking of the use of Mond gas at the Openshaw works, he said that their plant was doing well, and the only trouble they had was with tar. Whilst the sawdust in the scrubber was quite clean there was no trouble, but the sawdust did not last long enough. They were using bituminous slack, and one man was, generally speaking, capable of looking after the plant. His firm could lay claim to be among the first users of water gas. For sixteen years they had been using Dowson gas, developing recently some 600 horse-power. They were changing their system now on account of the price of fuel. He considered that, where such cheap gas could be obtained, electric driving was not so good as employing gas engines situated in suitable positions and having the gas brought up to them.

Sir Frederick Bramwell recalled how nineteen years ago he had ventured to prophesy, before the British Association, that in fifty years' time the steam engine would only be found in museums, because it was such an inefficient method of using heat. It seemed to him, hearing Mr. Humphrey's paper, that his prophecy was likely to come true. He also recalled that thirty-five years ago Sir William Siemens had tried to bring in a Bill to obtain powers for conveying power gas from the great coal centres to wherever it might be required. The Bill had been thrown out.

Mr. Isaac Carr, of Widnes, had a few questions to ask. He wanted to know what class of coal was used in the producers, and if any sort of coal is suitable. He asked because the United Alkali Company employed a Duff producer in which any class of coal could be used. He also would be glad to know if town refuse could be used? He had heard that it was in use, and that the recovery of ammonia was even followed with success. At Widnes there was a

250 horse-power engine driven by coke oven gas. He would like the author to tell them something about the tar, its removal, value, &c., and also if the use of gas-holders was a necessity.

Mr. Dowson said that it was important that they should look at the practical side of the problem. It was possible that in time they would see gas engines of 1500 horse-power each, and it was well to be prepared for their advent. The question of gasholders to which the previous speaker had referred was a matter of no little moment. It would be an admirable thing if the gasholder, which cost a good deal and occupied a lot of space, could be done away with. It was mentioned in the paper that no holder was used at Winnington. But he thought the reason they were able to do without it there was because the mains were large and the consumption of gas in the engines was only about one-twelfth of all the gas produced, the remainder being used in furnaces. They had thus a great surplus to draw on. In gas engines the suction is considerable, and when running at full load, making some seventy to eighty suctions a minute, the result is serious fluctuations in the main. He had seen gasholders rise and fall with each stroke of an engine. When two or more engines happen to synchronise the case is still worse. He thought that under ordinary conditions some means of equalising is necessary. Dr. Mond signified that Mr. Dowson's explanation of the reason no holders were required at Winnington was correct. Continuing, Mr. Dowson said that for consumption in furnaces no holder or other regulator was necessary. John Brown and Co., Limited, of Sheffield, used a Dowson generator without any means of storing the gas. He considered Mond gas valuable in many respects, but it should not be forgotten that it contained 16 per cent. of carbonic oxide, and there was therefore room for improvement. He admitted that the high percentage of hydrogen, 29 per cent., compensated for this in a large measure. Dowson gas has 20 per cent. hydrogen and only from 4 to 6 of carbonic oxide, but he is anxious, and always endeavouring to reduce the latter still further. He could not see the point of working a Mond plant without the recovery of ammonia, which he considered the principal set off to the great quantity of carbonic oxide. The author had given a comparison of electric and gas power. He had given the price of electricity at the switchboard. That was not what users wanted to know; they wanted to know the price on their premises. It would be valueless to tell a gas consumer the price of gas in the holder; he wants the price in his own meter. It was his opinion that power users should generate their own current, leaving the central station to provide electric lighting only.

Mr. A. Rollason said that a Mond plant of 1000 indicated horse-power capacity had been erected at the works of the Premier Gas Engine Company, Limited, Sandiacre, near Nottingham, and was started to work in February last, and has been in daily use making gas for the engines driving the works, testing engines, and in the foundry heating the core stoves and drying moulds. The plant was constructed without ammonia recovery, but with steam recovery towers, a portion of the exhaust gases from one of the engines is returned to the producer, the exhaust pipe from the engine being connected to the air inlet to blower. The fuel used is the common Nottingham slack, costing at the present time 10s. per ton delivered to the works. No extra water is required except that used for feeding the boiler, which is used to raise steam for driving a small engine of 8 horse-power, which drives the blower, pump, and dashes in the washer, the exhaust steam entering the air supply after leaving the air heating tower, and before passing to the regenerator. This plant was tested by myself for a period of three weeks, and the quantity of gas made varied from one third to the full capacity of the plant; the gases made at any load between this range were practically constant both in quality and quantity per pound of fuel fed to the producer. At full load 1 lb. of fuel fed to the producer gave 72·25 cubic feet of gas at 15 deg. Cent., resulting upon analysis of the following composition:—

H	24·00	B.T. units per cubic foot of gas at 15 deg. Cent. 145·9.
CO	16·00	
CH_4	2·20	
O	0·00	
CO_2	12·40	
N	45·40	
	100·00	

At a load of one-third, 1 lb. of fuel fed to the producer gave 70·85 cubic feet of gas at 15 deg. Cent., having the following composition:—

H	21·60	B.T. units per cubic foot of gas at 15 deg. Cent. 144·5.
CO	16·40	
CH_4	2·40	
O	0·00	
CO_2	12·40	
N	47·20	
	100·00	

The producer, after standing 14 hours, required 220 lb. of fuel to fill up, equal to 22 lb. per hour working. At the low load the fuel fed to the producer was 299 lb. per hour, and to the boiler 65 lb., or a total consumption of 386 lb. per hour, and the gas made per lb. of the total fuel used was 54·9 cubic feet at 15 deg. Cent. At a higher load the fuel fed to the producer was 686 lb. per hour, to the boiler 65 lb., proportion of stand-bye losses 22 lb., total fuel used 723 lb., the gas made per lb. of the total fuel used for all purposes was 63·55 cubic feet at 15 deg. Cent. In ordinary daily working at fair loads a good gas engine will give an indicated horse-power per hour on 1 lb. of common slack used for all purposes in a small Mond plant. The slack used was tested in a bomb calorimeter, and gave 12,200 thermal units per lb. One pound of this slack fed to the producer made 72·25 cubic feet of gas at 15 deg. Cent., having a heat value of 145·9 thermal units per cubic foot. The gas made from the 1 lb. of slack contained 10,451 thermal units out of the 12,200 in the slack, the producer having an efficiency of 86·4 per cent., this high efficiency resulting from the use of the steam recovery towers, and by returning part of the exhaust products to the producer. The same quality of slack was used in the boiler, and the quantity burned was greater than would be in one constructed to burn small slack or arranged for gas firing. During the ten months the plant has been at work no repairs have been required, and it has worked without a hitch or any trouble whatever. One man attends to the plant, and in daily work the time required from the starting of the blower forcing air to the producer to the time the gas engines are working is only 1¼ minutes, at the week end the time required is only three minutes, and when shut down for eight days under five minutes. There has been no time lost or fuel wasted blowing up during the time the plant has been at work.

The discussion was then adjourned till the January meeting.

The following list of gentlemen retiring from office, and the nomination list for the coming session, were read at the meeting. Retiring: Sir W. H. White, President; Arthur Keen and T. Hurry Riches, Vice-presidents. Sir W. Arrol, Wm. Dean, Bryan Donkin, H. Graham Harris, and A. Tannett Walker, Members of Council. Nominated by the Council for election as President, W. H. Maw; Vice-presidents, Arthur Keen and T. Hurry Riches; as Members of Council, Wm. Dean, Bryan Donkin, H. Graham Harris, A. Tannett Walker, Sir J. Wolfe Barry, Henry Lea, Sir W. T. Lewis, and James Swinburne. Professor Pullen nominated Mr. W. H. Fowler for a Member of the Council. The nomination was seconded by Mr. Hugh Campbell.

DOCKYARD NOTES.

A GERMAN newspaper prints a letter from Tokio concerning the Yakumo, the German edition of the Asama class. The temperature of her engine-rooms and stokeholds—according to this letter—is about half that in the Elswick cruisers. The Japanese are delighted with her, and, presumably, generally convinced that Elswick has not a look in where Germany is concerned. This is all very pretty, and legitimate enough in the way of national advertisement, but it is a trifle crude. There is "too much trowel" about it all. Our own information, we may mention, painted an exactly opposite picture, and we draw ours from naval sources. Apart from anything else, the Elswick cruisers carry a couple more guns and a couple more armoured casemates at the same price. This is a pretty hard brick wall for even a German head to knock against.

THE Russian first-rate protected cruisers to be built—some day—on the Black Sea, will be sisters to the Bogatyr. Displacement 6250 tons against 6500. They will be 436ft. long against 426ft., and 54ft. beam against a trifle less. They will draw less water than the Bogatyr. Like her they will carry two 6in. in turrets fore and aft, and four guns in armoured casemates on the upper deck. Four other 6in. will be behind shields—a useless defence in these days of lyddite shell. There is some talk of 8in. guns replacing the amidship 6in.

WE made a slight error in describing the new 18,000-ton battleships last week. It appears that they will only carry four 7·5in. guns. These guns, therefore, entail an extra 3000 tons of displacement, 750 tons per gun.

THE Formidable, now that she is nearly complete, is after all distinguishable from the Canopus class, as her funnels are differently placed.

THE reconstruction of the Inflexible proceeds slowly. The new masts are not yet up, and the only visible results of some months' labour so far are a number of additional ventilators on the bulwarks of the superstructure forward. If ventilators could do it, the Inflexible would be one of the finest ships in the Navy.

FOR some reason the old Glatton is in dock at Portsmouth just now. Given a single long 9·2 in a new turret, there would probably be uses for the Glatton; but as she is, it is difficult to see the wisdom of spending money on her.

THE Seagull, the museum in which the earliest type of Niclausse boiler is enshrined, has been out for some trials this week.

THE reconstructed Havock has three very high funnels, with the mast just abaft the fore one.

THIS week's *Le Yacht* contains a very good photograph of the new Italian cruiser Varese at full speed. To look at, the ship is nearly identical with the Belgrano, which was the subject of a large engraving in THE ENGINEER some eighteen months ago. The Varese's trials are given as follows:—Six hours' natural draught, October 20th last, 9479 horse-power, 95·71 revolutions, and 18·36 knots. Forced draught trial—runs—with pressure 201 lb., 105·585 revolutions, 13,885 horse-power, and 20·02 knots. The boilers are Belleville, with which type the Italians seem quite satisfied and able to get quite satisfactory results.

THE Japanese have adopted high explosive shells for all guns up to and including the 8in. The particular explosive employed is a Japanese invention, said to be equal to melenite in its effects.

THE Jane Naval War Game has been adopted by the United States Coast Artillery for use in connection with the attack and defence of fortified harbours. For naval purposes a number of different war games are now under experiment at the United States Naval College, but no definite decision appears to have been arrived at as yet. Hitherto, the Americans have used the game invented by the late Admiral Colomb, with American innovations and improvements, but this game makes no allowance for the various types of ships, guns, and armour.

THE Spartiate will re-commence her trials almost immediately after Christmas.

THE Japanese have decided not to build the torpedo depôt ship Toyohaschi, but to construct four destroyers instead. A Toyohaschi at present exists, but she is merely a "maru"—a converted merchant steamer like our Hecla.

LABOUR TROUBLES.

THE North-Eastern Railway strike is extending. This up to last week was confined to Tyneside. On Saturday it developed itself at Blyth, and both passenger and mineral traffic was seriously interfered with. The immediate cause of the extension was that two clerks had been ordered temporarily to take up the duties of railway guards, with the result that the engine drivers refused to proceed with such men in charge. Drivers, firemen, and guards then left the works in a body, and on Saturday evening it was feared that a still greater extension of the strike would take place. On Saturday the passenger train service was almost entirely suspended, and travellers desirous of reaching Tyneside had to rely upon road vehicles. By mid-day two trains had left Blyth, but it was uncertain how far they would go.

One of the many evil results of the strike has been the stopping of the Silksworth Colliery of Lord Londonderry, 3000 men being thrown out of work, but it is hoped only temporarily.

On Sunday evening a large meeting of Great Western Railway men was held at Treharris, to hear a report of the interview with Paddington officials concerning an application by signalmen for increased pay. Briefly the report was to the effect that the men would be re-classified from a secondary main line to a principal main line, which will mean an early advance of pay. It was also agreed that the signal-boxes should be re-classified, but the claim for Sunday pay was not entertained. Great Western Railway local platelayers, South Wales, to receive an increase of 1s. per week.

On Saturday, at Llantrissaint, a mass meeting was held, when it was decided to accept the 1s., but only as a part of the demand of the men.

The Taff Vale Railway agitation appears to have been only slumbering. Special meetings have been arranged for Sunday next to consider the question of the imported labour. The men, it will be remembered, returned to work after the strike in August last, conditionally on certain promises given to their Committee being carried out by the directors. The men were under the impression that this would have been done in a few weeks. A good deal of correspondence has taken place since, without a definite result, and the intention is to place the state of affairs before the men, and get a representative vote. One meeting is to be held in Cardiff in the morning, and another at Pontypridd in the evening.

Wages in the Forest of Dean collieries, about which strong complaints exist, proved the subject of discussion at a large meeting at Yorkly, Lydney, on Friday last. The meeting was addressed by Mr. G. H. Rawlinson, miners' agent. The complaint was the reduction of 10 per cent. Mr. Rawlinson said that the Wages Committee of the Labour Association were quite prepared to meet the general body of the men, and he believed they would be convinced that the men's representatives were well advised in agreeing to that reduction. Wages had gone up, and though they might be now going down, they would probably ascend again. Some of the men, he said, contended that they ought to have had notice of the reduction, but they did not complain when it was the other way about. The miners' agent, who was well received, concluded with a warm defence of the policy of maintaining a Conciliation Board.

The continuance in some of the South Wales collieries of non-unionists in employment was brought prominently before the monthly meeting of the Rhondda Miners' Society on Saturday, and it was decided that on the 1st of January the Lewis Merthyr Lodge, and that of the Tynewydd, should tender notices to terminate all contracts, in protest. Before the same meeting an exceptional case of great interest was heard. A collier named Morgan having suffered an injury, application was made for compensation, and as this was not granted an action was entered upon. While this was pending Morgan accepted a compromise of £40, leaving the Society to bear the burden of £11 costs incurred. The Chairman strongly condemned this, and it was resolved that a provision should be made against future cases of the kind.

A delegate meeting of South Wales steel workers was held on Saturday in Swansea, to consider the question of concessions in wages. Since the Steel Makers' Association intimated that at the end of the year they would terminate the agreement, by which they were paying their workmen 10 per cent. on the standard rate, the opinions of the different branches of the men's union have been ascertained, and these seem to be very divided. The merits of the question of concession were inquired into at length, and ultimately it was decided by the meeting to concede 5 per cent. in January, and a further reduction of 5 per cent. later on.

The quarries at Bethesda, North Wales, are to remain open until December 31st, by order. Most of the men are now working elsewhere.

The Penrhyn Quarries dispute has now taken another form, which may, possibly, it is hoped, have a successful issue. Private arrangements, it is understood, sanctioned, if not carried on by Lord Penrhyn himself, have been made, and on Monday four of the men's leaders proceeded to London and were met there by his lordship, who came specially from Bangor to do so. No particulars of the interview have been allowed to be disclosed, but confidence is expressed as to the outcome.

The Great Eastern Railway strike took, late on Monday night, a good turn. A mass meeting of railway men was held at Gateshead, when a resolution was passed to accept the company's offer to the effect that the men resume work until the general manager can receive a deputation, when all matters at issue will be discussed. Pending negotiations the mineral guards to be allowed to use, as before, their own vans in all cases where readily available and where no delay is caused by special shunting. In other cases first vans to be used. Further, all the men who left to be reinstated with payment of outstanding wages.

On Tuesday morning the carmen employed by Hayes and Son, Shoreditch, numbering about sixty, came out on strike on account of wages dispute.

According to a memorandum issued by the Labour Department of the Board of Trade, 17,513, or 3·2 per cent. of the members of trade unions, were reported as unemployed at the end of November.

In regard to wages, over 137,000 workmen obtained advances, averaging 6¼d. weekly per head, and 11,086 sustained decreases, averaging 1s. 7d. per head. The principal increases were in the coal mining industries of Monmouthshire and South Wales.

The notice presented by the tin-house men, South Wales works, has been withdrawn, an arrangement having been arrived at with regard to the employment of surplus labour about which a dispute arose. The men out of work are to be re-employed and share what work there is to be done.

RAILWAY MATTERS.

THE Swiss State Council on the 14th inst. ratified the agreement for the purchase by the State of the Central Railway system.

LAST week a Dublin jury awarded a passenger £2750 damages against the London and North-Western Railway Company for injuries received in an accident at Stafford.

IT is stated that the directors of the Great Western Railway Company have decided to make Stourbridge the centre of their signal works for the West Midland district.

ARRANGEMENTS have been made by the management of the Canadian-Pacific Railroad for erecting a new railway bridge over the Red River at Winnipeg. The bridge will have three spans, each 240ft. long.

THE Glamorgan County Council have under consideration an extensive scheme of light railways for the county, and steps are being taken to have the matter placed before Government by competent hands.

THE engineers of the Chemin de Fer du Nord have been making severe tests of the permanent way between Calais and Paris, and on other portions of the system, so as to reduce to a minimum any chance of an accident due to defective roadway.

IT has been announced in Berlin that the reconstruction of the Shan-Hai-Kwan to Tong-Ku Railway has been completed, with the exception of two bridges to the south of Lutai, the restoration of which will occupy another four weeks.

AN electrical engineer, at a salary of £1000 a year, is to be appointed by the London County Council to deal with the works of construction and reconstruction for electrical traction of the tramways. The new engineer will be directly responsible under the chief engineer.

A RACK railway has been built for the transportation of coal between the interior of the island of Sumatra and the port of Padang, on the South-West Coast. The main line of the track is 97 miles long, and of this 22 miles of track is constructed with a centre rack for cog-wheel operation.

THE strike of guards on the North-Eastern Railway, which began to assume a very serious aspect early in the week, was temporarily concluded on Monday night by means of a compromise. The directors have promised to allow the mineral guards to use their own vans in all cases except when such use will interfere with the traffic of the line by special shunting.

A COMMITTEE of the Canadian Roadmasters' Association has reported that the best method to prevent the creeping of rails on a soft or swampy road bed is to put on 18in. of cinders—to lay ties 10ft. to 12ft. long, and 7in. to 8in. thick, and not more than 8in. from bearing to bearing; also to block four ties on each side of the joint, under each rail, with angle bars of 4in. by 4in. scantling.

THERE are fourteen railway companies in Japan, with the total capital of 169,900,000 yen (£16,920,000), and this, added to the Govermental outlay for the railway construction, makes the whole amount invested in railways in Japan 250,000,000 yen (£24,900,000). If all the debts of the companies and capitals of those companies which have not yet opened to railway traffic were added, it would amount to more than £29,880,000.

THE Great Northern Railway of Canada has completed a contract with the Leyland steamship line, whereby it charters five boats of that line for five years to carry grain between Quebec and Great Britain. This will enable the Great Northern to run a weekly service between Quebec and England. The company announces that some of the largest steamers now running to Boston will be brought to Quebec next season for the export trade.

IT is announced that the promoters of the Tavat Valley Light Railway, from Llangynog to Oswestry, have received intimation from the Treasury that the free grant will be increased by £10,000. The capital required is not wholly made up, but there is every probability that it will be forthcoming shortly. In the case of the proposed light railway from Welshpool to Llanfair, the free grant has also been augmented by £7500. All the capital is now guaranteed.

THE following railway companies, viz., the Caledonian, Cockermouth, Keswick, and Penrith, Cleator and Workington Junction, Furness, London and North-Western, Maryport and Carlisle, North British, and North-Eastern, have instructed that the rates for the carriage of coke to the ironworks in Carnforth, Barrow, Askam, Millom, Maryport, Workington, Whitehaven, Cleator Moor, and other places on the West Coast, have been increased by 7½ per cent.

THE Board of Trade have recently confirmed the Light Railway Orders authorising the construction of a light railway in the county of Northumberland, between Gosforth and Ponteland; the construction of a light railway in the county of Gloucester, between Wotton-under-Edge and Charfield; and the construction of light railways in the parish and urban district of Rhyl, in the county of Flint, in extension of the light railway authorised by the Rhyl and Prestatyn Light Railway Order, 1900.

THE borough engineer of Bolton, Mr. A. Day, has reported on the bad condition of the tramway lines. He finds that the gauge varies considerably at different points, and the result of running the cars is disastrous. Oil grooves are "hammered" out of place as a result of jolting and twisting, the coils of motors are shifted and worn through the insulation, axles have been found to give way through the crystallisation of the steel, wheels have been worn and loosened, and the cars themselves wrenched.

THE Hull, Barnsley, and West Riding Junction Railway Company is about to ask Parliament for powers to make a number of extensions. A new line is to be laid from Thurnscoe to Denaby, another from Denaby to Rotherham, and another from Denaby to Maltby. The proposed lines from Thurnscoe to Denaby, and from Denaby to Rotherham, are in continuation of the policy of the directors to run trains from Hull straight into Sheffield. A further proposal included in the same application is to make a junction with the Midland Railway Company's Derby to Leeds line at the Kilnhurst passenger station.

A FEW weeks ago we announced that Mr. Parshall had been engaged by the Manchester Corporation to advise in regard to the electrical system. At a meeting of the Joint Sub-committee of the Electricity and Tramways Committee, held last week, it was resolved that Professor Kennedy be engaged to carry out the new electric power station at Stuart-street, the provision of transforming stations and distributing cables in connection therewith, and to advise with regard to Dickinson-street and Bloom-street stations and other incidental matters, subject to mutually satisfactory terms—including remuneration—being arranged.

THE office of superintendent of the Highland Railway has been vacated by Mr. William Garrow, on account of ill-health. Mr. Garrow has held the post for fifteen years. The directors of the company have appointed Mr. Thomas McEwen to the post of traffic manager, at a salary of £700 per annum. Mr. McEwen is chief assistant to the general manager of the Glasgow and South-Western Railway. He will have charge of both the goods and passenger traffic departments of the Highland Railway, succeeding to the joint offices of the late Mr. Thomson, goods manager, and Mr. William Garrow, superintendent of the line.

NOTES AND MEMORANDA.

THE new census returns for Berlin give a total of 1,884,345 inhabitants, as compared with 1,677,304 in 1895.

IT has been announced that the Queen has granted to the Royal Society Bushey House, Bushey Park, for the purposes of a National Physical Laboratory.

THERE were in operation in the United States at the close of last year eleven electrolytic copper refineries of a total annual capacity of 198,600 tons of copper, 170,273 oz. of gold, and 21,199,200 oz. of silver, having an approximate value of £16,500,000 sterling.

THERE has recently been exhibited in New York a motor carriage, in which the motive power is supplied by liquid air. Ten gallons of liquefied atmosphere is said to be sufficient to propel the carriage fifty miles. The motor is an ordinary twin cylinder vertical engine as used for steam.

IN the *Journal de Physique* for November, M. Raphael Dubois describes in a short note some experiments on the use of photo-bacteria as sources of illumination. By cultures on a large scale, with liquid nutrient media, the author states that it has been possible to illuminate a room with the brilliancy of moonlight.

IN Germany cork is said to have been used with success in isolating the vibrations and consequent noise caused by machines installed in or near dwelling-houses. A sheet made up of flat pieces of cork in mosaic fashion of corresponding size to the bed-plate of the machine, and held together by an iron frame, is laid under the machine.

THE first batch of the new 40-calibre 12in. guns for the United States navy has been tested, with the result that 360 lb. of smokeless powder gave a muzzle velocity of 2854 foot-seconds, and a muzzle energy of 47,994 foot-tons, with a projectile weighing 850 lb. The 12in. guns now in service have a muzzle velocity of 2300 foot-seconds, and a corresponding energy of 31,170 foot-tons.

THE latest proposal in connection with electric power transmission in the Tyrol is to utilise a waterfall on the Stillupback near Mairhofen. About 2000 horse-power is available from this source, which it is proposed to convert into electrical energy for transmission to the neighbouring township, besides to some gold mines, and possibly to a railway now being built in the Ziller valley.

LAST year 188 vessels were built in Italian yards, the tonnage of which was 48,687 gross and 33,802 net. In the previous year the number of vessels built was 163, and the tonnage was 27,721 gross and 19,478 net. Among the ships built last year were comprised 22 steamers, measuring altogether 41,388 tons gross and 26,789 tons net; 16 of them were built of iron. The remaining 166 were wooden sailers.

AT Nagasaki Cardiff coal now costs about 90s. per ton, while Pocahontas coal can be bought at 60s. The latter fuel has just been introduced into Japan, and bids fair to be largely used in the future. It is smokeless, contains a very high percentage of pure carbon, a correspondingly low percentage of ash, and in addition it is comparatively clean to handle. As an economical steaming coal, experts find that it is little, if at all, inferior to the best qualities coming from the Welsh collieries.

THE balance-sheet of the Paris Exhibition has been issued. The total receipts were 114,456,213f., which includes 60,000,000f. from the lottery bonds, 20,000,000f. from the State, 20,000,000f. from the Paris Municipality, and nearly 9,000,000f. from rent of sites, altogether about 114,000,000f. The expenditure exceeds 116,000,000f., comprising 89,000,000f. for buildings, 8,500,000f. for management, and 13,000,000f. for general outlay. The total cost to the French nation is therefore about 42,000,000f.

A COMMITTEE appointed by the American Association of Railway Superintendents of Bridges and Buildings have recently issued a report on the use of pneumatic tools for riveting and repairing. A comparison of the work done in the erection of 2455 lineal feet of brickwork showed that with the pneumatic riveter two men and a heater averaged 500 rivets per day, whilst by hand 250 was good work for three men and one heater. An inspection of the rivets shows the work to be superior to the hand work.

THE total imports into Switzerland in 1899 amounted to £46,504,000, or an increase of nearly £10,000,000 since 1895. Of this total amount of imports, the United Kingdom only supplied the small proportion of £2,257,000, or about 4·8 per cent., while Germany's share amounted to £13,812,000, or nearly 30 per cent. Thus, while Great Britain is Switzerland's second best customer, taking nearly £7,000,000 worth of goods per annum, she has to content herself with the seventh rank amongst the exporters to Switzerland.

H.M. CRUISER Pandora, which was built and engined in Portsmouth dockyard, returned to harbour on Saturday, on the conclusion of a thirty hours' trial at half power. She developed 1789 indicated horse-power starboard and 1849 port, or a collective indicated horse-power of 3638, and with 196 revolutions starboard and 194·4 port she averaged a speed of 16·7 knots, with a coal consumption of 2·11 lb. per unit of power per hour. She is now ordered to carry out an eight hours' trial at 5000 and a four hours' trial at 7000 indicated horse-power.

THE efficiency of the acetylene flame was recently discussed in the *Physical Review* by Mr. E. L. Nichols, who has been carrying out some experiments on the subject. The author gives the radiant efficiency as 0·105, or practically the same as that of the arc light, which is equally "cold," and twice as "cold" as either the incandescent or the Welsbach lamp. The contrast with the radiant efficiency 0·32 of the vacuum tube remains therefore as great as ever. In the matter of total efficiency, on the other hand, the acetylene lamp stands very high. The figure given is about 0·02, or double the corresponding figure for the arc light. The magnesium flame alone, with its efficiency of 0·1, is superior to the acetylene flame.

IN Austria, where everything in the shape of fuel is being carefully investigated, sawdust is impregnated with a mixture of tarry substances, and heated to the proper temperature; it is then passed over a plate of iron heated by steam, from which a screw conveyor takes it to a press, where it is compressed into briquettes of the required size. The press turns out nineteen blocks per minute, weighing two-fifths of a pound each, and measuring 6in. by 2½in. by 1¼in. The calorific power, says the United States Consul at Coburg, is about the same as that of lignite, with but 4 per cent. of ash. One factory produced last year over 7,000,000 briquettes, costing about 8d. per thousand, and selling at from 4s. to 4s. 2d.

ACCORDING to the report of the Labour Department of the Board of Trade, the state of employment during November again showed a decline when compared with the corresponding month in 1899. Compared with the previous month there was a further falling off in several of the more important industries, but owing principally to a continued decrease in the number unemployed in the cotton trade, the percentage returned as unemployed by trade unions showed a slight decline. In the 138 trade unions making returns, with an aggregate membership of 539,175, 17,515—or 3·2 per cent.—were reported as unemployed at the end of November, compared with 3·3 per cent. in October, and with 2·2 per cent. in the 123 unions, with a membership of 509,274, from which returns were received for November, 1899.

MISCELLANEA.

A LARGE harbour-extension scheme, to cost 1,900,000 marks, is about to be carried out at Dantzig.

EXPERIMENTS with the Zeppelin air ship will be resumed next spring. The inventor has received £3000 to carry them out, an amount said to suffice for twelve ascents.

THE machinery pavilion erected for the United States in the Paris Exhibition has been bought by Mather and Platt, Limited, of the Salford Ironworks. The pavilion is a large steel-built shed.

WE learn that a scheme is on foot for widening the Suez Canal, and that Mr. L. W. Bates, of London, has been asked to try some experiments to ascertain whether the proposal is practicable or not.

THE Town Council of Penzance has under consideration several schemes for increasing the supply of water for the town. The Sanitary Committee have approved a scheme for sinking a shaft in close proximity to the present reservoirs.

THE Tenby water scheme is now to be confined to an expenditure of £13,500, and the water to be obtained by filtration of the Ritec supply. The Pwllheli Council will submit their scheme of a harbour of refuge to the Board of Trade; expenditure £60,000.

IT is said that there is no potato machinery of any consequence made in Canada. The growing of potatoes is one of the important interests of the farmer, and it would seem that the field is open and inviting for the British maker of potato machinery of all kinds.

A MASSIVE loving cup has been presented to the Mayor and Corporation of Crewe by Mr. F. W. Webb, chief mechanical engineer of the London and North-Western Railway Company, an ex-Mayor of Crewe. It is intended for the use of the present and succeeding occupants of the civic chair.

IN January a new twin-screw steamer called the Canterbury will be placed on the Dover-Calais service. She is being built on the Clyde, and will be the first vessel of this type used on the cross-Channel service. The Calais-Douvres has been sold, and, it is said, will make her appearance on the Liverpool—Isle of Man service next year.

ON behalf of Lloyd's Committee, Colonel Hozier has informed Glasgow shipowners that it has been decided to establish experimentally the reporting of vessels by etheric signalling at Inisbtrahull, North of Ireland. It is expected that the installation will be ready by the middle of January. Arrangements are also being made for night signalling, as well as day, at Kildonan, Arran, Scotland.

THE new first-class battleship Prince of Wales is to be built at Chatham. The vessel will be on similar lines to those of the Implacable, now completing at Devonport. She will have a length of 400ft., breadth 75ft., mean load draught 26ft. 9in., and a displacement of 15,000 tons at load draught. She will be fitted with engines capable of developing 15,000 indicated horse-power, and giving her a speed of 18 knots. Her guns alone, it is said, will cost £75,000, whilst her total cost when completed for sea will be over a million pounds.

THE Clyde Navigation Trustees are about to make a comparison of electric cranes with the present hydraulic cranes along the southmost quay of the Princes Dock, Glasgow. An experimental electric crane, capable of lifting three tons, is to be erected and a series of tests instituted as to the electric and the hydraulic energy requisite in the respective types of cranes. The question of working coal tips by electricity has also recently been brought before the Trustees, but as there is said to be only one such tip as yet in use—at Rotterdam—the Trustees have deferred action meantime.

ACCOUNTS received from Assuan with regard to the Nile irrigation works state that the river is expected to be low again next year. If so, it is hoped that the whole of the foundation work for the dam will be completed in the coming season. In a recent interview Major Hanbury Brown, Inspector-General of Irrigation for Lower Egypt, stated that it was impossible yet to foretell what next year's Nile would be like, but from a careful comparison of previous records with those of this year now available, it seemed probable that there would be a low Nile again in the summer.

THE Isthmian Canal Commission in their report unanimously recommends that the most practicable route is the Nicaragua route, the cost of which will amount to £40,108,000. The cost of a canal by the Panama route is estimated at £28,468,000 according to one route and at £31,275,000 according to another. The value of the work already done by the French at Panama is estimated at £6,786,000, and the commission points out that if the United States acquired the Panama concession from the French company it would not obtain absolute ownership in perpetuity, as the concession provides that the canal shall pass to Colombia at the end of ninety-nine years.

AT a conference on the drainage of the Western Valleys, held at Abercarn, it was resolved that an engineer be engaged to advise upon the best scheme for dealing with the drainage and sewage of the Ebbw Vale, Nantyglo and Blaina, Abertillery, Abercarn, and Risca urban districts, and so much of the St. Mellon's district as lies in the Ebbw watershed. The scheme of the county surveyor provides for a main trunk sewer from Nantyglo, Ebbw Vale, and Tredegar, down through the valley of the Ebbw and the valleys of its tributaries, with an outfall into the Channel, about 1½ miles east of Peterstone Church. The rough estimate of the cost of the work is £180,000.

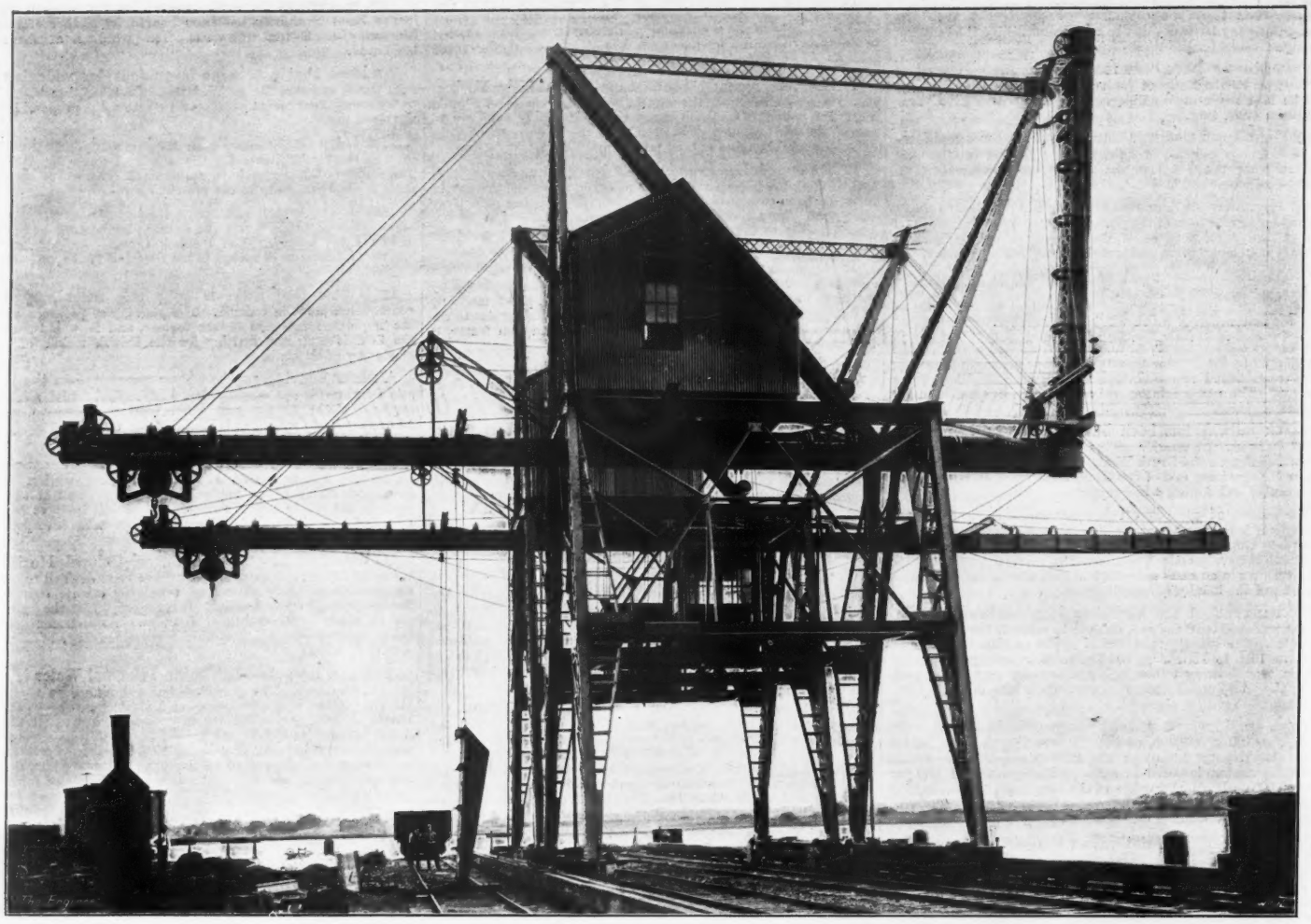
THE remarkable activity of German commercial travellers in Switzerland is commented upon by the British Commercial Agent in his annual report on the trade of that country. It appears that last year no fewer than 3828 travellers representing German firms obtained the necessary permits from the federal authorities to travel in Switzerland; while French manufacturers sent 1176 travellers. The samples brought into Switzerland by German commercial travellers weighed 211 tons; while British samples only amounted to 35 cwt. Many of these travellers visit Switzerland three or four times a year; but they do not limit themselves to these periodical visits. British traders, on the other hand, contented themselves with sending 28 travellers to Switzerland, against 49 in 1898.

A MEETING of gentlemen interested in the mining industry of the country was held at Winchester House on Wednesday to consider the best means of bringing about a revival of mining in Cornwall. Mr. J. H. Collins presided, and moved, "That it is desirable to form a Chamber of Mines having for its first objects *inter alia*: (*a*) To make known to mining investors the merits of the mineral deposits of the West of England. (*b*) To keep before the public the doings of the chief 'productive' and 'progressive' mines. (*c*) To answer the queries of subscribers in relation to such mines, and to warn them against such enterprises as seem to be of a bogus character. (*d*) To advise and recommend such general enterprises as water trusts, drainage plans, &c., with a view to the exploration and development of extensive mineral areas." The resolution was carried. The following list of officers is to be submitted to a further meeting of members for confirmation, modification, or otherwise:—Committee: Messrs. Edward Ashmead, J. H. Collins, Benedict Kitto, F. Retallack, A. H. Singleton, James Osborne, William Thomas, C. V. Thomas, Charles Twite, James Wickett, W. Derry, and J. H. Hosking.

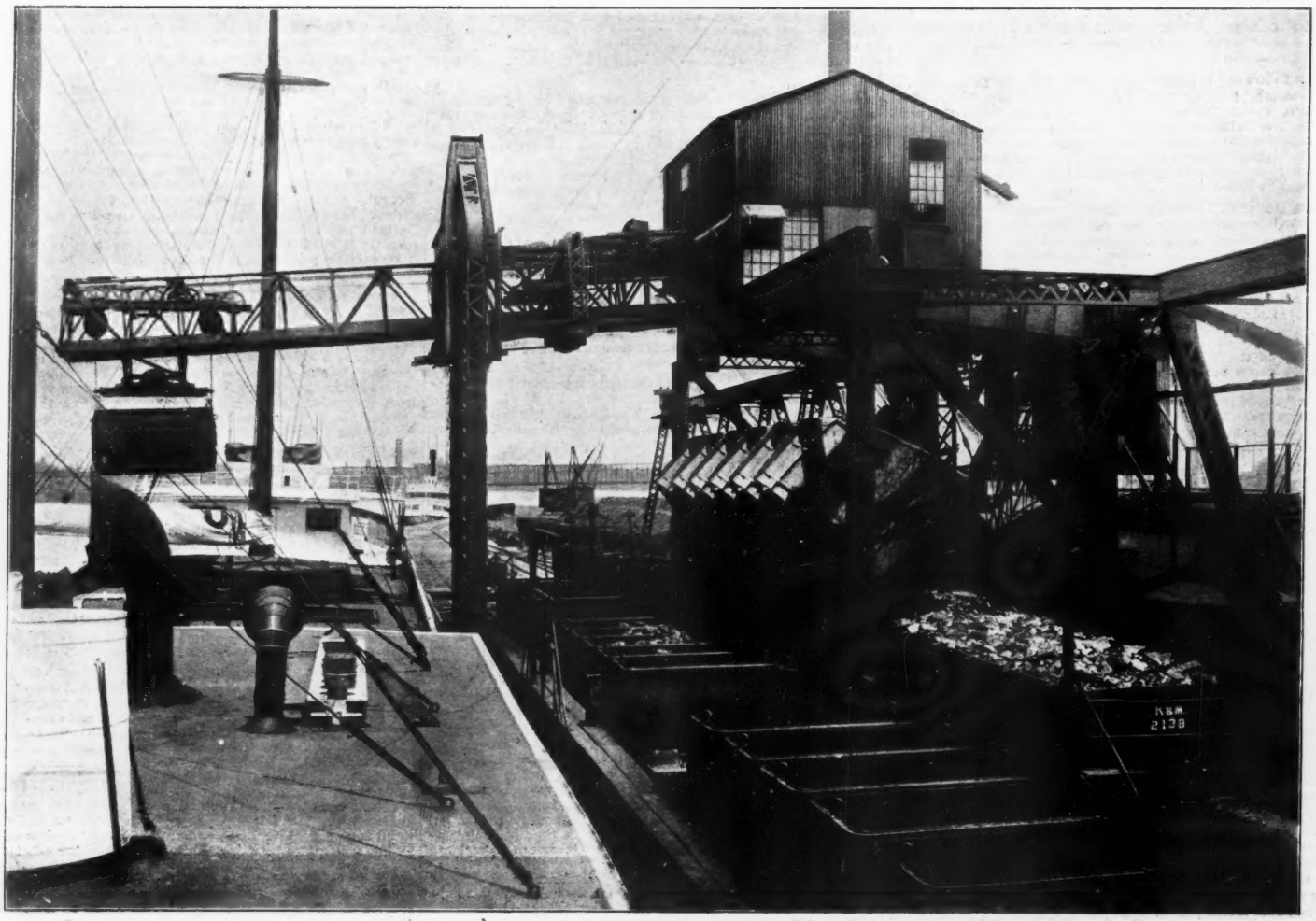
CARGO CONVEYORS—PHILADELPHIA AND READING RAILWAY

THE BROWN HOISTING MACHINE AND CONVEYING COMPANY, CLEVELAND, OHIO, ENGINEERS

(*For description see page* 614)



FAST PLANT CONVEYOR



CAR DUMPING MACHINE

THE WIDENING OF LONDON BRIDGE.

IN the year 1800 a Special Committee was appointed to report upon the condition of old London Bridge, the predecessor of Rennie's present handsome structure, which is justly regarded as one of the monuments of the City. The conclusion at which the members of the Committee arrived was that the ancient bridge was no longer able, having regard to the safety of the public, to discharge its duties. Its condemnation and demolition followed as a natural result, and also rendered imperative the erection of a successor.

Commenced in 1824, and opened for traffic seven years afterwards, the existing London Bridge remained undisturbed and unharassed for a period of twenty-two years. Then its troubles began. The establishment of the railway station close to the approaches on the Surrey side of the river gave rise to an increase of traffic, both vehicular and pedestrian, which was never anticipated by the designer of the bridge, and which taxed to the utmost its carrying capacity. The first demand for its widening was made in 1853, and has been maintained with more or less activity and persistence until it has culminated in the present scheme, which requires only the sanction of the Legislature to become an accomplished fact.

It was confidently expected that the opening of the Tower Bridge six years ago would put an end to all the suggestions and projects for widening its neighbour on the up-stream side. These anticipations have not been fulfilled, for although the vehicular traffic has been less since that date, the pedestrian traffic has not been reduced. This circumstance will account for the fact that the present scheme, which we proceed to describe and illustrate, scarcely affects the existing roadway, but is chiefly devoted to dealing with the lateral expansion of the footways. We may here, perhaps, make a brief reference to the larger scheme for widening the bridge, to the extent of accommodating six lines of vehicles. To effect this alteration, a carriageway of 50ft., with central refuges, 3ft. in width, and footways, 15ft. wide, would be required. The total width of the bridge would thus be increased to 83ft., which would represent an additional 15ft. on each side of the present structure. An outlay of about £300,000 would be required to effect this alteration alone, not including the cost of widening the north and south approaches. In addition to these reasons, this project was abandoned, especially in view of Sir Benjamin Baker's opinion that it would be unsafe to extend the present foundations.

The scheme comprises in the proposed widening the retention of the present four lines for vehicular traffic, and the lighting of the bridge from small refuges placed in the middle of the roadway, instead of by the old clusters of lamps fixed upon the parapets over the centre of each arch. The lateral expansion of the whole structure is from 53ft. 5in. to 65ft. These increased dimensions allow of a width of 34ft. 6in. for four lines of vehicles, of 2ft. 6in. for the central lights, and allot 14ft. to the breadth of each footway, instead of the limited 9ft. 6in. which has prevailed up to the present time. In addition to the amount of actual structural work involved in the proposed alteration, the design includes the necessary arrangements for electric lighting, re-paving, and re-pointing of the masonry, together with the building of all gullies and suitable provision for hydrants. The cost of all these extras, as they may be termed, forms part and parcel of the total estimate. An additional trifling sum of £600 would suffice to permit of the carrying out of a very desirable improvement, which would consist in tilting outwards the parapets across Upper Thames-street, which are still within the lines of frontage.

It has been assumed that the width of the bridge need not be greater than that of its narrowest approach. The width of King William-street, immediately northward of Upper Thames-street, is 65ft. 3in., and just south of King William-street it widens out to 74ft. 10in. To the south of Denman-street, the width of the Borough High-street, at the point where it commences to open into the wide space leading to the bridge is 71ft. 7in. Conceding the correctness of the original assumption, it is apparent that the future width of 65ft. in the clear between the inside of parapets will satisfactorily meet all the exigencies of the case. The result arrived at respecting the width of the widened structure is in strict accordance with the well-known axiom that no thoroughfare is wider than its narrowest part.

Before passing on to a description of the plans and sections, a few words should be said about the foundations, for which purpose we cannot do better than refer to the report of Sir Benjamin Baker to the Bridge House Estates Committee. In it he observes that "it has never been contested that an unequal settlement of the foundations occurred during or immediately after the completion of the bridge, but Sir John Rennie stated in 1867 that no further movement had occurred during the forty years which had then elapsed, and I find nothing in the reports since submitted to me to show that this statement was not perfectly correct. In a report dated 25th March, 1889, Mr. More arrived at the conclusion that no appreciable alterations of levels had occurred between 1875 and 1889—a period of fourteen years; so adding this to Sir John Rennie's forty years, we get a practical state of repose for fifty-four years accounted for up to 1889, and since then no appreciable settlement has been noted. I do not attach much value to small variations in levels taken by different persons at long intervals of time, and I am of opinion that since the original unequal settlement of the piers and abutments no movements of the slightest practical importance have occurred. I have no doubt that the original movement was due partly to the withdrawal of timber piles near to the foundations and partly to the squeezing out of the softened clay round the pile heads, but the holes formed by the piles having been once filled up and the softened clay squeezed out, there would be no reason to anticipate any further settlements of practical importance. It must be remembered that in all bridges founded on piles and timber platforms slight movements must be expected, because, although the timber does not decay in the ordinary sense of the word under water, yet the exterior skin of the wood becomes somewhat spongy, and so a little squeezing down and settlement of piers and abutments may occur, but a settlement of this kind in no way affects the stability of the structure, nor the question of whether a little more load may be safely imposed upon a given bridge. I have no doubt that slight movements of the preceding kind have occurred in the past, and that they will continue to occur in the future in the case of London Bridge whether the load on the foundations be lightened or increased within reasonable limits. This fact, however, is not of the slightest practical importance, and may be dismissed in considering the expediency of widening the bridge according to any of the designs referred to in this report. The present average pressure on the foundations under the piers of the bridge is about five tons per square foot, and the greatest additional pressure imposed by any of the systems of widening submitted would be only 67 lb. per square foot, which is, of course, an entirely negligible quantity."

It is further observed in the same report that "as regards the stability of granite arches to sustain the additional load of the widening, no calculations are necessary for the enormous reserve of strength in bridges such as London Bridge." It may be stated that the present load of the structure upon the London clay foundations is 4·94 tons per superficial foot. The widening by granite would increase the pressure to 5·02 tons, while the adoption of cast iron as the material would reduce it to 4·88 tons. The difference is too small to have any influence upon the final method adopted. In the case of the Tower Bridge the load does not exceed four tons per square foot.

So soon as it was definitely determined to abandon the proposed method of increasing the pedestrian capacity of London Bridge by means of cast iron cantilevers and balustrade, the adoption of the granitic design became unavoidable. Yet it is but fair to the metallic alternative briefly to allude to the fact that it possessed several good points in its favour. It afforded greater facilities for the practical execution of the work; it reduced the weight upon the foundations, although to but a comparatively small extent, as previously pointed out; and it was more economical in cost. Experience, however, had conclusively esta-

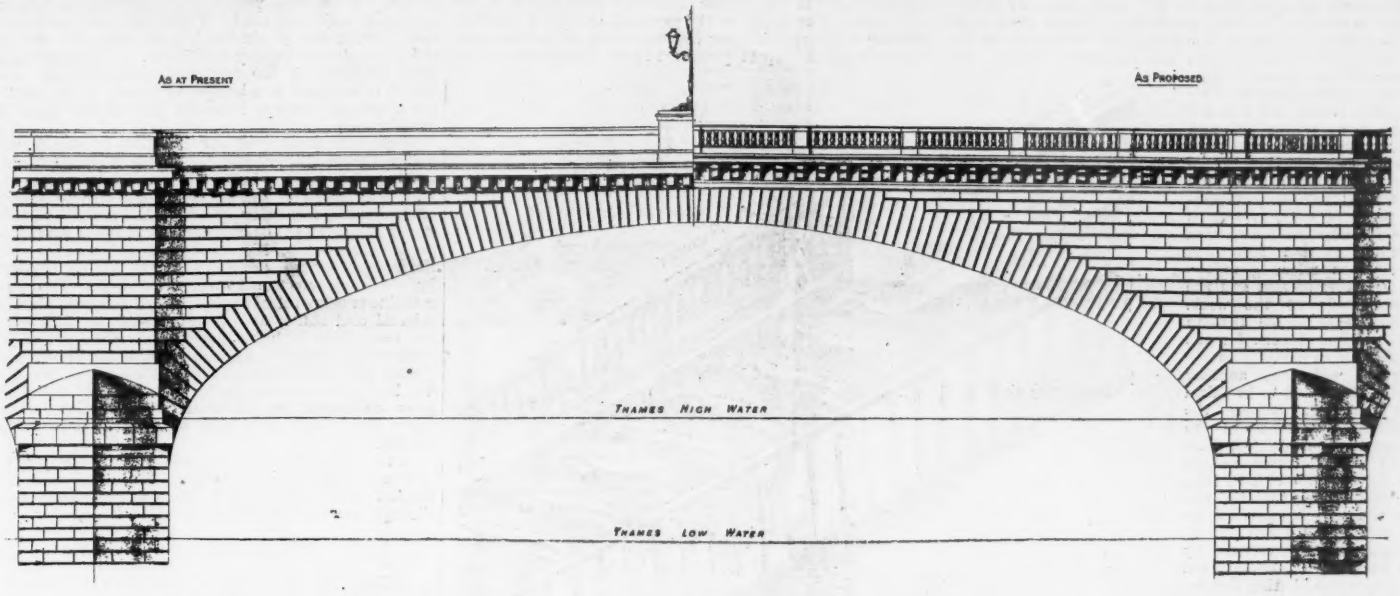
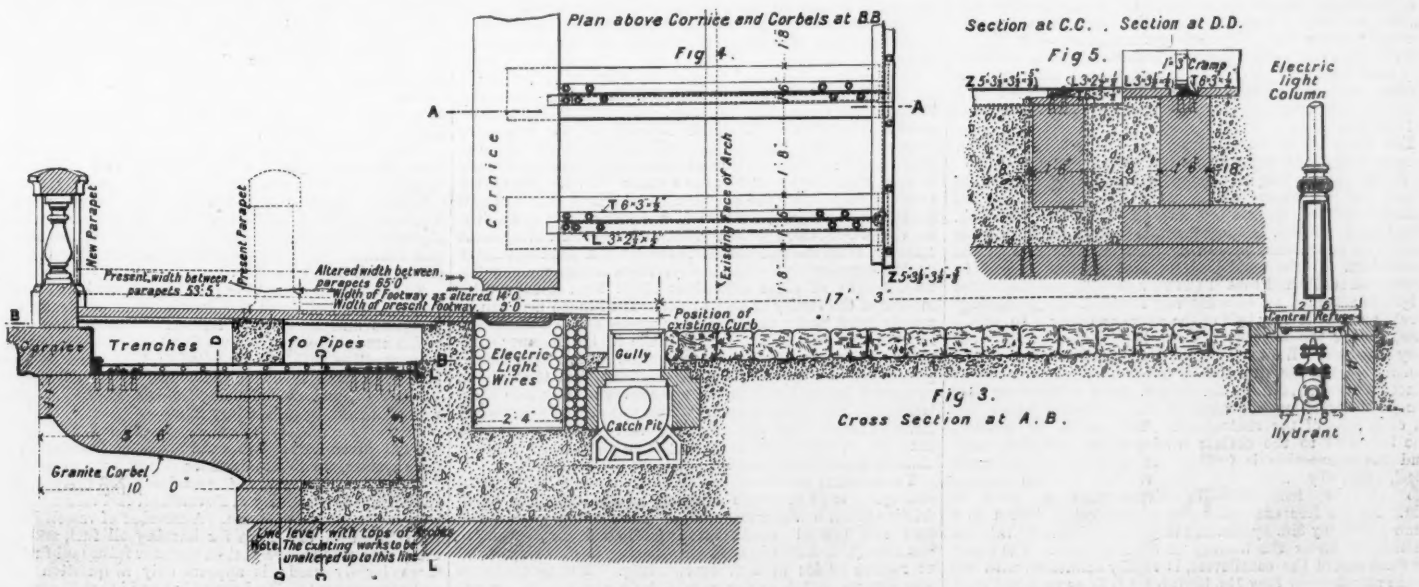


Fig. 1—WIDENING OF LONDON BRIDGE—ELEVATION OF CENTRE ARCH



SECTION OF LONDON BRIDGE

blished that it was open to numerous and serious objections from the æsthetical standpoint, and that the promotion of any such scheme would infallibly meet with the same vigorous opposition which wrecked it when brought before Parliament in 1879 and also on previous occasions.

It will, we think, be generally admitted that the future elevation, or the river façade of the structure, will not suffer in comparison with the present. An inspection of the elevation of the centre, and a portion of the two adjacent arches will render it apparent that the widening with granite corbelling or cantilevers and an open balustrade is quite consistent with the architectural features and characteristics of the bridge, and is also free from the objections which were urged, and with reason, against the other design. One half of Fig. 1 shows the elevation of the old as it may be now termed, and the other half that of the new mode of construction. That the appearance of the structure—at least of the upper portion of it—is altered by the substitution of open balustrades for the original solid parapets, and by the projecting cantilevers, cannot be denied. In order, however, to obtain data upon which to form an opinion respecting the real effect of the alteration, which no drawing can adequately supply, the Bridge House Estates' Committee, at the suggestion of Sir Benjamin Baker, had a model made showing the old and new designs, which confirmed them in their selection. There is not very much in the alteration, from an engineering point of view, as will be apparent when we have drawn attention to the remaining illustrations referring to the general cross section and the other details of the work. It should be stated that in the selection of 65ft. for the width between parapets in the proposed widening, another consideration had to be taken into account, besides the minimum dimensions of the approaches to the bridge. This width was increased in the iron construction to 67ft. 6in., the reason being that the granite widening is restricted by the size of the stones procurable for the cantilevers and by the necessity of limiting the load upon the existing foundations. In regard to the objections that have been raised against the open balustrade, that of Waterloo Bridge is of a very similar pattern, although the remark is not intended as a precedent.

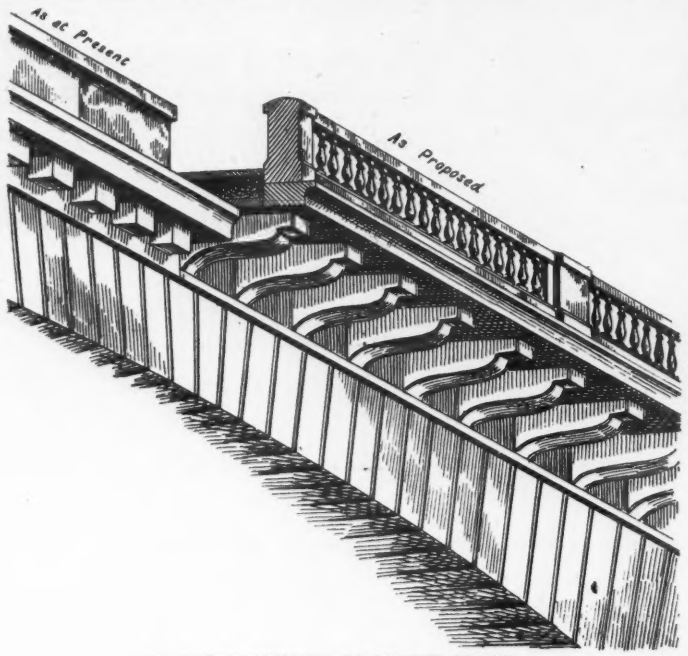


Fig. 2—THE WIDENING OF LONDON BRIDGE

The constructional part of the alteration to London Bridge—which, although it has yet to receive the final sanction of Parliament, may be regarded as almost certain of execution—will be readily understood by a reference to the sections in Figs. 2, 3, 4, and 5. A general cross section of one-half of the roadway and footways of the structure as proposed to be altered, is shown in the first of these figures. It may be observed that the actual width of the present roadway between the kerbstones does not practically undergo any change. It is true that the kerbs of the new footways are set back, as in Fig. 3, to the extent of 1ft. 3in. from the old line, but the erection of the new lighting refuges, which are 2ft. 6in. in their widest part, exactly compensates for this concession at the sides. The roadways consist of granite blocks, 12in. by 9in., laid upon a bed of concrete, and it is satisfactory to observe that proper provision has been made for the placing of electric light wires. This arrangement will altogether obviate all necessity for breaking open either road or footways.

The widening of the footpaths is effected by means of granite corbels or cantilevers, 10ft. in extreme length, 1ft. 1in. in depth at the free or unsupported end, and 2ft. 9in. in depth, for the whole part of them which is *encastre* and fastened down within the face lines of the present structure. This part is 4ft. 6in. in length, which leaves 5ft. 6in. for the length of the actual projecting part or lever arm of the cantilevers. If the total load, or load per foot run, of the pedestrian traffic and that of the new parapet and flagstones might be assumed to be uniformly distributed, the leverage would amount to only half of the above quantity. In either case, neither the leverage nor the load to be carried exceed very moderate limits. Upon the upper surface of the cantilevers, in the direction of their longitudinal axes, is placed a tee steel, 6in. by 3in. by $\frac{7}{16}$in., fixed to them by four $\frac{7}{8}$in. lewis bolts passing through the horizontal flange, two at each side of the central rib. This mode of securing the tee steel to the corbels is adopted at both their ends, and the connection is further strengthened by an angle steel, 3in. by 2$\frac{1}{2}$in. by $\frac{7}{16}$in., riveted to the central rib of the tee steel by rivets with a pitch of 6in. At the free extremity the angle steel is bolted to a cramp 12in. by 3in. by 1in. in thickness, which is let into the stonework under the bearing of the flagstones. The other, or fixed end of the cantilevers, is rigidly connected with the main structure by long 1in. lewis bolts L L, as seen in Fig. 3. To each bolt at its upper end is attached a Z or angle steel 5in. by 3$\frac{1}{2}$in. by $\frac{7}{16}$in., riveted through its other horizontal flange to the angle steel already described, and also secured to it by a small angle knee. Beneath the joints of the paving stones are attached U sections of steel 3$\frac{1}{2}$in. by 1$\frac{1}{4}$in. by $\frac{7}{16}$in.

A plan of the extension of the footways is represented in Fig. 4, taken beneath the flagstones, in which the breadth of the corbels is 1ft. 6in., and the distance between them in the clear is 1ft. 8in., as also shown in the cross section in the next figure. In the former figure the Z steel is broken as it runs the whole length of the bridge, and serves not only to anchor down each individual cantilever, but to connect them altogether in one rigid continuity. In Fig. 5, which is a cross section at right angles to Figs. 3 and 4, the 1in. anchor lewis bolts are shown double, that is, two to each cantilever.

Some of the remarks made by the City Surveyor in his report of the 19th January of the present year, with regard to the electric lighting of the bridge, will well reward perusal. He observes that should it "be decided to widen the bridge, upon which subject I have to-day prepared a report, I would recommend that the lighting of the roadway should not be from the sides, which would meet with the decided opposition of the Conservators of the River Thames, under Section 137 of the Thames Conservancy Act, 1894, but from the middle by means of seven arc lamps of 800 candle-power each, placed on columns 20ft. high, giving five times as much light as at present. Even in this position the Conservators may object to electric lighting, but they would not have so strong a case. There may be an objection to light from the middle of a road in that the vehicles intercept some light to the foot pavements, but observations of the lighting in Euston-road and Hampstead-road do not, to my mind, bear out this objection, while the economy of cost in current and maintenance is very considerable, besides which the work of trimming and repairing can be done without interfering with the convenience of the foot passengers."

The cost of the entire scheme is estimated not to exceed £100,000, which is not a very large sum, having regard to the immense boon it will confer upon the inhabitants of the metropolis. The design of the proposed alteration, together with the plans and sections accompanying our article, were contained in the report presented to the Committee of the Bridge House Estates, by Mr. A. Murray, the City Surveyor, and Mr. F. Cruttwell, M. Inst. C.E.

FAST CARGO CONVEYOR.

A part of the mechanism used in transferring cargoes of coal, metal, and other heavy freight to vessels at United States seaports is what is known as a "fast plant conveyor." Its use has become an important factor in reducing the cost of transportation of low-grade freight to foreign ports, as it is a rapid and cheap substitute for a large amount of manual labour.

The machine illustrated on page 612 is known as the three-ton plant machine, and is built by the Brown Hoisting Machine and Conveying Company, of Cleveland, Ohio. The particular machine illustrated is used at the tidewater terminals of the Philadelphia and Reading Railroad near Philadelphia. It is constructed of structural steel, and built to rest upon a track which has a gauge of 27ft. This gives ample room to allow the machine to overhang two standard gauge railroad tracks. There is a folding beam extending, on the water-side, over one track and over the water, about 42ft. 6in. from the rail nearest the water. A fixed cantilever on the opposite side extends over three tracks, making the total length of these extensions 115ft. 9in., with a total motion of the trolley of about 100ft. The hinged arm can be readily lifted by the motor to clear vessels at the dock, and is lowered and controlled by a strap brake in the manner common to bridge, tramway, and ore hoists. The motor house, placed on the upper deck of the machine, and that of the operator's house lower down, are apparent from the illustration. The wheels upon which the structure rests are double-flanged, and by shafting and mitre gears the machine is made self-propelling from the motor. While shifting a cargo the machine is clamped to the track.

The hoisting machinery includes one two-rope hoisting and conveying machine, with complete equipment; one band-friction drum hoisting machine, with drum 40in. in diameter, and two special band-friction pulling drums, 48in. in diameter, the drums in each case having faces wide enough to receive cables without overwinding. The motor-house contains an electric motor, wound for a continuous current of 500 volts, with a guaranteed capacity to hoist 6000 lb., with an allowable overload of 25 per cent., at the rate of between 200ft. and 400ft. a minute; also to propel the trolley with this load along the tramway at the rate of from 600ft. to 800ft. in a minute, and, in self-propulsion of the entire structure on the track, to attain a speed of from 50ft. to 75ft. a minute. The necessary controller, rheostat, gearing, and clutches are furnished to make all desired motions of the machine parts without reversing the motor.

Electric current is carried from a lighting and power station. Two 0000 cables, rubber-covered, and placed underground, feed a naked 00 trolley wire, which is placed about 19in. from the ground and boxed in along the line of the machine's location. The cables are so arranged as to feed into the trolley wire at both ends. The laying of this cable is of interest, in that it is below the water-line of high tide, and therefore at each rising of the tide, is submerged by seepage. It was therefore thoroughly waterproofed, and in preparing the ground and boxing for it, it was necessary to provide a gravelly sub-soil that would readily drain.

In addition to the Philadelphia and Reading, the Pennsylvania Railroad Company has twenty-six of these machines installed at various points on Philadelphia and New York harbours, in addition to those used by other railroad companies.

Another machine which is being used extensively along the Great Lakes in the transfer of coal and ore from vessels to railroad cars and *vice versâ*, and which is being introduced for loading heavy freight along the Atlantic seaboard, is what is known as the car dumping machine. This is also the invention of the Brown Hoisting and Conveying Company, and by its use the contents of an open car can be transferred to a ship's hold in less than one minute. The apparatus is also built of structural steel, and travels upon a track, one rail of which is erected upon steel girders and the other built upon the surface of the wharf. It is built with one or two arms, according to the nature of the work to be performed.

It is fastened to the cradle by electrical clamps, and elevated at such an angle that its contents are thrown or dumped into a sheet steel framework containing a series of pockets. From these pockets the material slides into hopper cars on an adjoining track. These cars, also made of sheet steel, contain five or six hoppers or tubs. To each end of the tub is bolted a heavy steel hook. A traveller operating upon the arm of the machine, which extends over the wharf, is attached to a hopper by means of the hooks and machines, and conveys it to the hold of the vessel in the usual manner.

While one portion of the machine is transferring the material from the railroad car to the hopper car, the arm and traveller, working independently, are loading the vessel. As will be noted in the engraving, the arm or conveyor is really double, admitting of a double motion, by which an empty hopper can be hauled back while a loaded one is carried aboard ship. Hydraulic pressure is used for operating the dump or swinging cradle, while the loading is performed by steam or electric power, as desired. The dumping machine is being introduced at several points in place of the original coal chute, as soft coal loaded by this process is not reduced to such fine particles as when poured from a considerable elevation through the ordinary chutes into the vessel's hold with nothing to break the force of its fall. This has been the criticism applied to several of the older coal piers constructed on tide water, that the cars are so high above the vessel's hold that the coal is badly broken by the fall.

In the operation of the coal dumping machine but three or four men are required to control all the movements, while the fast plant machine can be controlled by a single operator through levers located in the operator's house.

BURMAH OIL-FUEL APPARATUS ON S.S. KHODOUNG.

On Wednesday, the 5th inst., the s.s. Khodoung, a petroleum tank steamer, which has been built by Sir W. G. Armstrong, Whitworth, and Co., Limited, for the Burmah Oil Company, of Rangoon, went out to sea, from the Tyne, for a trial of the machinery and the oil-fuel apparatus and burners. This vessel is intended for the transport in bulk of Burmah petroleum or kerosene from Rangoon to Calcutta, between which ports the vessel is to trade, and all the arrangements have been designed to meet these requirements. The vessel, during construction, has been surveyed by Messrs. Jacobs and Berringer, and also by the surveyors to Lloyd's Register.

The Burmah Oil Company has extensive oil fields and wells in Burmah. Its refinery alone, near Rangoon, employs a great number of men in the production of what is known as Oriental kerosene, bazaar oil, jute oil, and other products derived from the distillation of Burmah petroleum oil. The steamers and boilers belonging to the company use entirely for the generation of steam what is described in the East as "earth oil-fuel refuse." It is at low temperatures of the consistency of lard, and steam coils are required to keep it in the liquid form when employed in regions of low temperature. It has a very high flash point, which, it is stated, is considerably above 200 deg. Fah. The machinery, which has been constructed by the Wallsend Slipway and Engineering Company, is of the triple-expansion type, and of the newest design, having three cylinders, 19in., 31in., and 51in. diameter, with a stroke of 36in., and is placed, as is usual with oil tank steamers, at the after end of the vessel.

Steam is supplied by two single-ended boilers, working at a pressure of 180 lb. per square inch. An extra large boiler is also fitted for auxiliary purposes. All the boilers, both main and auxiliary, have been designed to burn Burmah oil-fuel refuse with Orde's burners.

The oil-fuel bunkers form part of the vessel, and have been very strongly built, and the arrangements generally are of a complete and satisfactory nature. The oil fuel burners, which are in duplicate to each furnace, and the arrangements in connection with the installation, have been designed by Mr. Orde, who is connected with Sir W. G. Armstrong, Whitworth, and Co. During the trial all the oil apparatus worked in a very satisfactory manner.

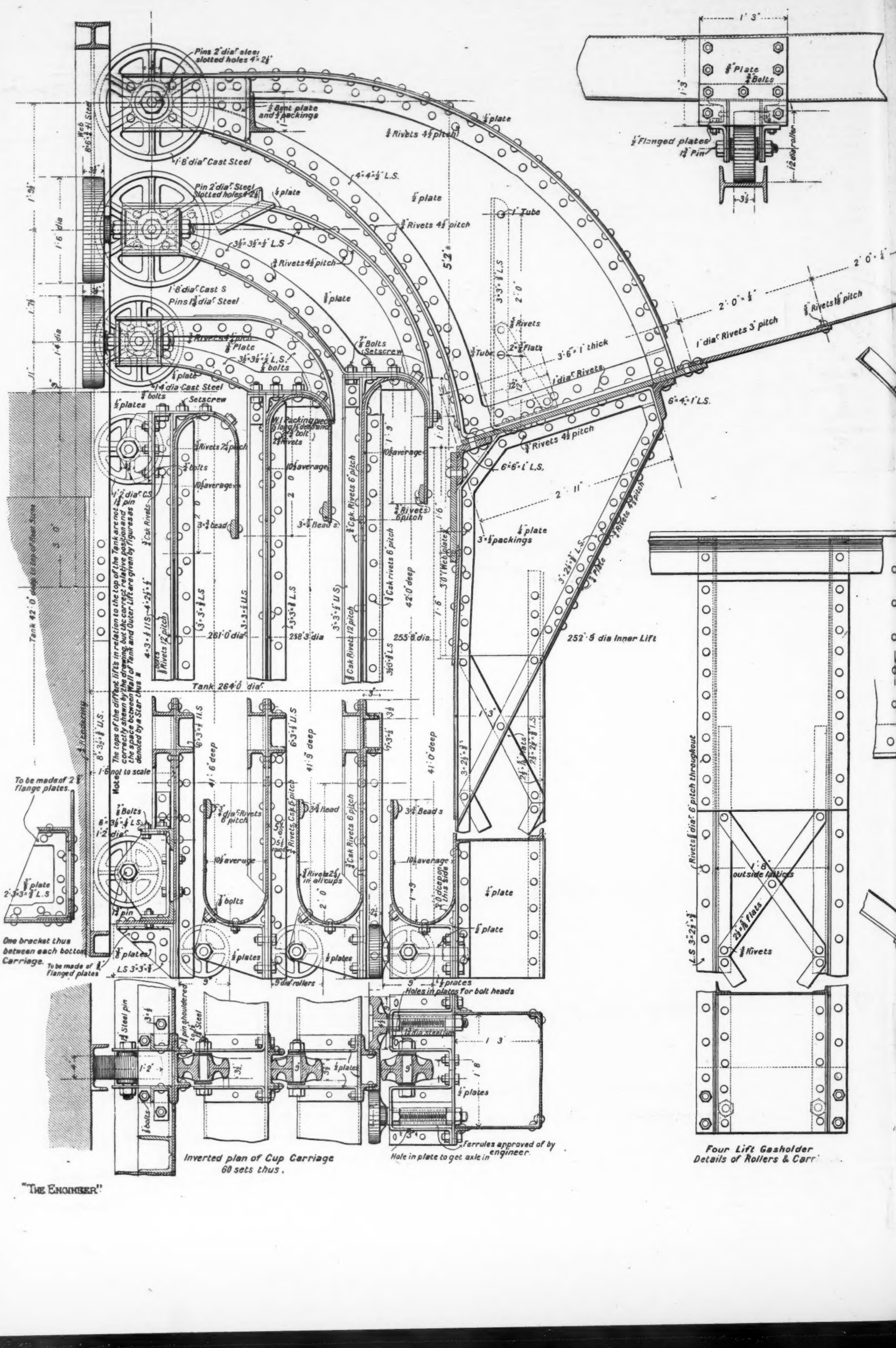
As we have already in our issues of May 25th and June 8th last given a complete and illustrated description of the Orde system, we do not consider it necessary to do so now.

The point of interest of the trial was that this was the first occasion in this country of Burmah oil-fuel refuse being used for the generation of steam. A number of vessels have now been fitted on the Tyne for burning oil fuel, and there is every reason to believe that in the near future oil fuel will be more largely used; it appears only a question of time and arrangement. We have only to add that the machinery during the trial worked admirably.

A Patriotic Counterblast.—Our British contemporary, The Engineer, greatly daring, denies that orders have been given to American companies on behalf of the authorities in South Africa. Inasmuch as I have already given undoubted proofs that such orders have been placed in America, it may be assumed that The Engineer is indulging in a little rhetoric to keep up its spirits. The Engineer takes the position practically that at the present time British makers have more work than they can turn out. It affirms in so many words that, the moment orders begin to slacken, they can obtain all the trade they want. It is, however, a mistake to undervalue the power of the British engineer in securing orders. During the past few years an immense quantity of automatic machinery has been put into all the best engineering works, and it is undoubtedly true that there has recently been immense capital outlay upon all sorts of new machinery. But the British engineer is at the present moment badly handicapped by the fact that he is within an appreciable distance of a shortage of raw material, while labour is distinctly scarce. In the engineering trade unions only about three per cent. are receiving unemployed pay.—*Iron Age.*

FOUR-LIFT GASHOLDE A

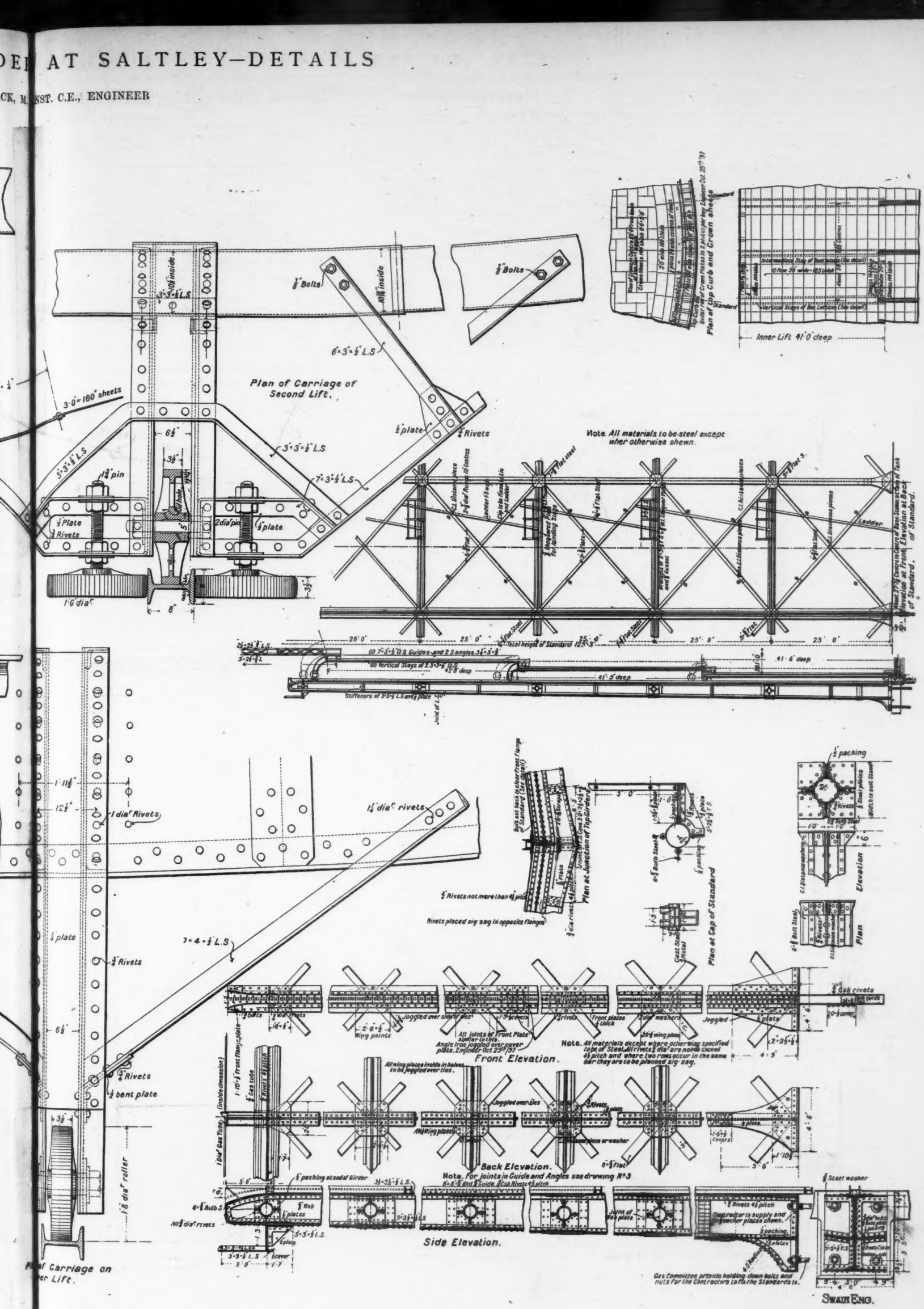
MR. HENRY HACK, M. INST. C


Pins 2' dia.r steel slotted holes 4" × 2½"
½ Bent plate and ½ packings
½ plate
¾ Rivets 4½ pitch
1'8" dia.r Cast Steel
4" × 4" × ½" L.S.
Pin 2' dia.r Steel slotted holes 4" × 2½"
3½" × 3½" × ½" L.S.
1" Tube
5'2"
Pins 1¾" dia.r Steel
1'4" dia
2'0" × ½"
1" dia.r Rivets 3" pitch
¾ Rivets 1⅝" pitch
⅞ Bolts (Setscrew)
3½" × 3½" × ½" L.S.
½ Tube
2" × ½" Flats
3'6" × 1" thick
1" dia.r Rivets
6" × 4" × 1" L.S.
Rivets 4½ pitch
6" × 6" × 1" L.S.
2'11"
3" × ½" packings
Rivets 2¼ pitch
10 @ average
2'0"
3" × ½" Bead s
¾ Csk. Rivets 6" pitch
¾ Rivets 6" pitch
42'0" deep
Tank 264'0" dia.r
261'0" dia.r
258'3" dia
255'2" dia.
252'5" dia Inner Lift
3" × 3" × ½" L.S.
3" × 3" × ½" U.S.
6" × 3" × ½" U.S
6" × 3" × ½" L.S
3" × 2½" × ½" L.S
Rivets ½" dia.r 6" pitch throughout
1'8" outside lattices
2½" × ½" Flats
¾ Rivets
Tank 42'0" dia.r
Masonry
8" × 3½" × ½" U.S.
1'6" dia
1'4" dia
Web 6'6" × ½" M. Steel
1'3"
⅝" Plate ¾ Bolts
½" Flanged plates 1½" Pin
1'2" dia.r roller
3½"
To be made of 2 flange plates
6" × 3½" × ½" L.S.
1'2" dia.r
1½" pin
2" × ½" × 3" × ½" L.S
One bracket thus between each bottom Carriage.
To be made of flanged plates
L.S 3" × 3" × ½"
Holes in plates for bolt heads
Ferrules approved of by engineer.
Hole in plate to get axle in
Inverted plan of Cup Carriage
60 sets thus.
Four Lift Gasholder
Details of Rollers & Carr

"THE ENGINEER"

DE AT SALTLEY—DETAILS

CK, M. INST. C.E., ENGINEER


Plan of Carriage of Second Lift.
Plan of top Curb and Crown sheets
Inner Lift 41'0" deep
Note. All materials to be steel except wher otherwise shewn.
Front Elevation.
Back Elevation.
Side Elevation.
Note. For joints in Guide and Angles see drawing N°3
Note. All materials except where otherwise specified to be of Steel. All rivets ¾ dia' are not to exceed 4½ pitch and where two rows occur in the same bar they are to be placed zig-zag.
Plan at Junction of Top Girder
Plan at Cap of Standard
Elevation
Plan
Joint of Web plate
Gas Committee provide holding down bolts and nuts for the Contractors to fix the Standards to.
Total height of Standard 125'0"
41'6" deep
41'5" deep
Stiffeners of 5'5½ L.S and ¾ plate
Rivets placed zig zag in opposite flanges
Joggled over ties
Joggled over joints
All wing plates inside in halves to be joggled over ties.
Contractor to supply and punch plates shewn.
Ladder
SWAIN ENG.

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PUBLISHER'S NOTICES.

⁂ *With this week's number is issued as a Supplement a Two-page Drawing of a Four-lift Gasholder at Saltley. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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TO CORRESPONDENTS.

⁂ *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

⁂ *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

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REPLIES.

G. OF NIGL.—With efficient plant you will be able to run ten 16-candle-power lamps per horse-power; with 8-candle lamps the efficiency is rather less.

G. J. T.—We do not know at what angle coal will stand. The angle varies with the size, and the way in which it is packed. We do know that a well-built 14in. wall will carry with safety ordinary house coal heaped against it 8ft. high, so that in all probability your 8ft. wall would be quite safe.

D. C. MACC. (Saltburn).—We would suggest that you should, in the first instance, send for the two volumes, I. and II.—Theory and Practice—of the *Electrician* Primers, which you can obtain from the *Electrician* Printing and Publishing Company, Limited, Salisbury-court, Fleet-street, E.C. The price is 2s. 0d. each post free. If after reading these you should wish for any further help, we shall be pleased to give it to you.

J. P. (Huddersfield).—Suppose the nut to have locked dead fast on the stud, the force tending to twist the stud is 30in. ÷ ·5in. × 100 lb. = 1500 lb. at the edge of the stud. The load on the end of the spanner which would twist the bolt off is $= \frac{278\ d^3\ k}{30\text{in.}}$, where d is diameter of bolt and k is the ultimate shearing resistance per square inch of the metal of which the bolt is made; k may be taken as from 20 to 25 tons per square inch for steel. The tension in the bolt, supposing the nut to be frictionless, can be found thus:—Whilst the spanner is being moved round once the bolt is raised ¼in. The load on the spanner is exerted at a radius of 30in.; in one turn it has travelled through 180in., whilst the bolt has lifted only ¼in. The tension then is 180 × 8 × 100 = 144,000 lb. on the total area of the bolt.

ERRATUM.

On page 559, second column, twenty-eighth and twenty-ninth line from bottom of page, read Wallage and Gilbett for Wantage and Gillett.

MEETING NEXT WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Thursday and Saturday, December 27th and 29th, at 3 p.m. Afternoon Lectures on "Great Chapters from the Book of Nature," by Sir Robert Stawell Ball, D.Sc., LL.D., F.R.S.

DEATH.

On the 10th inst., at 5, Albert-mansions, Crouch Hill, London, of pneumonia, EMILY FRANCES ALEXANDRA, the beloved wife of JAMES B. BALL, Assoc. M. Inst. C.E., and daughter of Mr. and Mrs. Shapley, of Torquay.

THE ENGINEER.

DECEMBER 21, 1900.

ELECTRIC LOCOMOTIVES.

WE have already dealt at some length with Mr. Langdon's paper on the supersession of the steam by the electric locomotive. That paper our readers now have complete before them. We have directed attention to what we regard as mistakes made by Mr. Langdon. These mainly referred to his under-estimate of the power required to haul trains. On this point those who took part in the discussion which followed the reading of the paper were fairly unanimous. It is unnecessary to say more just now about this question. Our purpose at present is to direct attention to the very remarkable statements made by Mr. Sprague. That gentleman spoke not only as an electrician but as an engineer—an electrical engineer, in fact. The concatenation of titles does not represent a branch of either profession in which the world has had reason to place much confidence hitherto. But we must not let so trifling a circumstance prejudice us in any way or warp our judgment. Yet we are somewhat in a dilemma. If Mr. Sprague be right, it seems to be time that engineers came forward and told the electricians how certain things were to be done, an event which could not redound to the credit of the electricians. On the other hand, if Mr. Sprague be not right, then he has done electricians an injustice. Mr. Sprague astonished his hearers by telling them that it was useless to question the accuracy of Mr. Langdon's figures, because it was simply impossible to make the required locomotive. "He could only say that an electric locomotive to do the work done by a steam locomotive was absolutely impossible. There could be no question of the supersession of the steam locomotive, because the electric locomotive did not exist that could perform the same duties." This statement, complete and categorical, must come as a shock to those very advanced people who have foretold that the time will arrive, and that soon, when the electric locomotive will be found careering over the face of the world, while the steam locomotive goes to the scrap heap.

We do not pretend to claim for the electrical system an advantage over the steam system save in two or three points. In the first place its use would be of direct benefit to the inhabitants of large towns, to the pollution of which the furnaces of our locomotives add something even on the best managed lines. Further, if very high speeds are to be attained, we believe that a considerable benefit will be derived from the use of non-reciprocating machines; and, lastly, we see no reason to doubt that the cost of upkeep of the electric locomotive will be much less than the outlay for a similar purpose on the steam locomotive. On the other hand, we know that the consumption of fuel per train mile will be much higher than it is now. There is with electricity a constant loss of energy at every step between the boiler and the driving wheels, and the only possible countervailing commercial advantage is that the steam engine in a central station may be more economical than a locomotive, and that to such an extent as to over-ride the step-by-step loss of efficiency to which we have just referred. But waiving altogether the economy or the reverse of the electric locomotive, we may discuss the far more important question involved in Mr. Sprague's announcement, and proceed to ascertain whether it is indeed true that it is beyond the art of the electrician to produce an electric locomotive capable of running, say, from Euston to Crewe while exerting 600 or 700 horse-power. This is only in part an electrician's special question, and it admits, we think, of being dealt with in a fairly satisfactory way from the point of view of the mechanical engineer.

Mr. Sprague's contention is that any electric motors that could be applied to two or three pairs of axles of a locomotive must be too small to produce 700 indicated horse-power, or anything like that power, for any considerable period without getting overheated. In short, he holds that no railway motor can be of more than about 50 indicated horse-power if it is to be safe. Now a train weighing 300 tons gross, will have, say, 50 axles, and a 20 horse-power motor on each would easily give 1000 horse-power. Thus it will be seen that, so far, electric locomotion on a railway is not impossible. Indeed, separate motors under the coaches is specially favoured by Mr. Sprague; and when one particular method of accomplishing a purpose or attaining an end has been accepted as the best by a man, it will usually be found that he is prejudiced against alternative solutions of the problem. We must bear this in mind when dealing with Mr. Sprague's views. The plan of putting a motor under every coach is not without very grave disadvantages, which are felt so keenly on tramways, that attempts to use electrical locomotives instead are regarded with the utmost favour. If our readers will turn to our issue for September 28th, they will find illustrations and a description of an electric locomotive exhibited at Paris by La Société Suisse, of Winterthur, provided with a motor which will work with safety up to 200 horse-power. But it is only necessary to mention the fact that the electric locomotive is in demand. Electricians will readily understand that there are certain methods of construction which tend to prevent overheating; and it may be taken as admitted that motors capable of exerting as much as 1000 indicated horse-power can be used on land with as much safety and absence of overheating as a dynamo. Mr. Sprague maintains that there is not space available on the locomotive. The actual space available on an English railway may be taken as 30ft. long, 9ft. wide, and 13ft. high, or say 3500 cubic feet. Let us suppose that the axis of the motor was arranged longitudinally; then while still retaining a fairly large driving wheel, it would be possible to construct motors with armatures about 8ft. in diameter, and six or eight of these might be disposed on the central shaft. We are not now suggesting that this arrangement would be in any way the best. We are only considering what is possible. It is known that all motors and dynamos generate heat, and that means must be provided to carry off that heat. The means utilised are a current of air; given this of sufficient power, and proper direction, and there will be no overheating unless some inexcusable blunder is made in the construction of the electrical part of the machine. Mr. Sprague's argument thus narrows itself to the proposition that it is impossible within the available limits of space to secure ventilation enough to keep a motor cool when working to 700 or 800 horse-power. We do not think the thesis can be maintained. At a speed, say, of fifty miles an hour, something like a hurricane would be driven through a tube in which the motors, mounted, as we have said, on a longitudinal axis, would be suspended. A dozen arrangements suggest themselves to us as to the way in which this method could be utilised. It may be argued, however, and reasonably argued, that when the train started the speed would be too slow to provide the requisite ventilation. We venture to assure our electrical readers that even this difficulty might be overcome by the aid of fans, to be kept in motion for the time being.

In short, the mechanical engineer would come to the aid of the electrician, and would say to him, "If you will provide sufficient torque to draw the train, I will undertake to provide sufficient air current to keep the motors cool." If the motors are to be shut up in boxes or close carriages they will certainly become overheated; but this and overloading it is easy to avoid. It would appear, then, that Mr. Sprague takes too pessimistic a view of the matter; and before his statements can be accepted as conclusive, he must prove that it is impossible by any available means to keep the motor cool. That a motor of the required power cannot be produced which will fit into the available space is, we think, an untenable proposition. Indeed, electric locomotives are in use in the States of very much more than the required power. It is not that the motor cannot be constructed, but that it cannot be kept cool, is Mr. Sprague's contention. Whatever the objections to the electric locomotive may be, we do not think that this is one possessing much force.

THE EXPLOSION AT ST. HELENS.

THE verdict which has been given in favour of the St. Helens Corporation in their action against the United Alkali Company to recover damages for the loss sustained in the disastrous explosion of chlorate of potash, which took place in the defendant's works last summer, makes it clear that for a chemical manufacturer to plead ignorance of the nature or attributes of his products will not avail him in cases of the sort under notice. Furthermore, it emphasises the importance of the manufacturer making himself thoroughly familiar with the properties of his products, more especially in relation to their explosive or toxic effects under the conditions of their manufacture,

and, as far as he is able, with regard to their use by his customers. By the latter paragraph we mean that where poisonous materials are supplied as specialities to take the place of harmless bodies formerly used, it should be considered incumbent on the supplier to notify the buyer that certain risks or eventualities may be apprehended, so as to enable the latter to take any precautions which prudence may dictate. We are all familiar with the enactments relating to the sale of poisons by retail chemists, and the regulations to which the purveyors of petroleum and of fireworks have to submit, but it is rather singular to note how very little parental supervision is exercised by the Government over those who deal in dangerous bodies by the ton instead of by the drachm. Of course it is argued that the manufacturers of chemicals in bulk are fully aware of what they are about, and that there is no need to impose any vexatious restrictions on the conduct of their businesses. Recent events, however, tend to show that there are many manufacturers who do not know all that it seems desirable they should know about the materials they use and the products which result. No one would accuse the United Alkali Company of attempting to carry on its extensive and complex manufactures by rule-of-thumb or on unscientific lines, yet the verdict which has been given against it seems to show that it cannot altogether be acquitted of negligence in taking it for granted that the use of wooden cisterns, and the storage of such a vast quantity of chlorate of potash in a confined space, was unattended by any risk to life and property. The company profess to be completely surprised at the demoniac power which was so suddenly and so painfully rendered evident; yet there are certain well-known rules and regulations anent the manufacture and transit of the article which surely go to show that it is regarded as having dangerous properties. Thus it is the rule to carry on the grinding operation under stone rollers in an isolated building, and to work only upon limited quantities at one time. Further, the regulations which have long been in force with regard to the clothing of the workmen show that the necessity for precaution is recognised. Then, again, in the matter of ocean transit the chlorate is only accepted as deck cargo, in common with bisulphide of carbon and other bodies which have aroused the suspicion, if not the positive aversion, of the shipping companies. It is easy enough to be wise after the event, and we certainly do not wish to write as if the discovery had just been made that chlorate of potash was a highly dangerous body to have to deal with, for, of course, it is nothing of the sort. But although the sudden zeal shown by the property insurance officer—after the St. Helens explosion—in inquiring how many ounces of chlorate analytical chemists and others kept on their premises—may be considered quite superfluous and ill-founded, there can be no doubt that those who have to deal with the substance in bulk should exercise more caution than has hitherto been considered necessary. Whether the result of the recent action will move the Home-office to consider the substance as an explosive in the meaning of the Explosives Act we do not know, and do not care to conjecture, but there certainly seems good reason to consider the advisability of such action, which opinion is based upon the statements of those who have taken a prominent part in the manufacture in years gone by, and not on statements made on one side or the other in a court of law. We have said that the United Alkali Company, with its scientific staff, is in a position to make itself acquainted with the properties of its products, and the case, in our opinion at least, should be the same with chemical manufacturers generally. But is it so? We fear not. Certainly, a good deal of the rule-of-thumb working of the past has given place to more scientific procedure, and the factory is now, much more commonly than of yore, under the fostering care of a skilled chemist. But what has been gained in one way we seem to be in some danger of losing in another. Take the case of the impure glucose which has attracted so much attention of late. One of the partners is reported to have said that he himself and his co-directors were guiltless of any knowledge of chemistry. We take this statement from a report in a daily paper, and do not wish to be understood as vouching for its accuracy. It is only fair to state that the gentleman just quoted said that he had implicit confidence in the chemist employed by the firm. However, this is a side issue, and, indeed, the glucose question has only been mentioned at all to point a moral as to the undesirability of the boards of chemical factories being composed of men eligible in every way as regard financial position and business acumen and integrity, but whose knowledge of matters of detail in connection with the products turned out is confessedly academic. There seems to be a serious element of danger in this, and in these days of limited companies and gigantic combines it is a danger which threatens to increase rather than diminish. The fact that a company, perhaps of large capitalisation, may be dependent entirely for its existence upon the care with which a too often inadequately paid subordinate performs his allotted duties, is one that can hardly prove reassuring to shareholders, and the latter should see to the protection of their interests by stipulating that those in immediate authority should be capable of intelligent scrutiny of the work done or left undone by members of the staff.

We have wandered away somewhat from our main topic, the explosion at St. Helens; the point the judge and jury had to try was, however, that of responsibility, and there cannot fail to be many chemical manufacturers who will profit by the issue. This case, of course, is distinct from one in which damage from fire results from spontaneous combustion, or from explosion on the premises of the purchaser; but the question of responsibility in such cases as these is one that has arisen more than once. Take, for instance, lampblack; under certain conditions, which do not seem to be universally known, this body is very apt to undergo spontaneous combustion, a fact of which the railway companies are fully aware, to judge by their special regulations with regard to its carriage and storage. The question arises whether the merchant who buys such lampblack in the ordinary way of business has any claim against the manufacturer thereof for any damage resulting from subsequent spontaneous combustion. That claims of the sort have arisen is a fact, but as we are not aware of any which have come before a legal tribunal, we do not feel at liberty to go into any details. Our own view, however, is that in any cases of the sort both parties to the action must be deemed cognisant of the danger to be apprehended. The manufacturer who pleaded that he did not know of the probable danger should be ruled out of court, and the buyer and user of the material should have scant sympathy shown him for omitting to make himself acquainted with the properties of what he is buying.

The essence of a successful business management is a thorough knowledge of detail, and this desideratum is hardly likely to be attained in the chemical trade if the habit of choosing directors from amongst those who are ignorant, not only of the manufacture involved, but of chemical science generally, becomes at all common. *Obsta principiis* is a valuable maxim, and it cannot be too strongly taken to heart by those who are concerned with manufactures which, if carried out in an incompetent manner, or with a lack of necessary foresight, may lead to lamentable consequences. Ignorance in the case of chemicals may turn out to be productive of anything but bliss, and no avoidable scope should be left for its manifestations. In making these remarks, which, though suggested by the St. Helens explosion, are not at all limited to that case alone, it is perhaps hardly necessary to say that we have no personal animus in the matter, which is one, indeed, rather outside the circle of subjects usually commented upon in these pages. Our sympathy is extended to the defendants in the action referred to, and all the more as it is clear that there was no criminal negligence. In venturing, as we have done, to support the contention of counsel for the plaintiffs, that manufacturers of chemicals should make themselves thoroughly familiar with the behaviour of such chemicals under varied conditions, we may seem to be taking up a position which is unjustifiable, and one, moreover, with which the manufacturer could not fairly be expected to comply. However this may be, if the principle that ignorance of the law is no defence is interpreted by juries to apply to cases where ignorance in chemical works has led to disaster, then it will be seen that those primarily concerned have no option but to pursue their scientific investigations beyond the point of successful production into the wider field of behaviour under varied or abnormal conditions.

MERCIER—AND AFTER.

To the vague invasion schemes of General Mercier we did not feel called upon to refer in detail; nor do the vapourings of M. Lockroy or of General de la Rocque demand, *per se*, any especial attention. M. Lockroy is by now well known as an ultra faddist, an amateur with brilliant ideas, but little, if any, practical knowledge behind them. He did the French navy much good by his seeking after efficiency; but that was a thing apart from his naval ideas. As for the generals—well, military views upon naval possibilities have never gone for much, but General de la Rocque's wild statements are merely absurd. They may serve to bring about the attempted invasion one day; but faith in his notions would simply entail the deaths of many gallant Frenchmen.

It is in a way a pleasure to turn from the opinions of these men to the expressions of intellectual Frenchmen on the same subject. In *Le Yacht* this week, though the actual invasion scheme and General Mercier are merely referred to casually, there are both a leading article on the French fleet and its prospects against England, and a letter from M. Normand, the famous torpedo boat builder, on the same text. Of these M. Normand's letter is the more important because of the weight of his name, and the singularly level-headed way in which he discusses his subject. Summed up, what M. Normand says is this:—The battleship for a long day yet will be the principal fighting unit. To attain success with battleships, numbers are essential. It is impossible to reduce the armour or armament without seriously hampering the prime efficiency; economies must, therefore, be made in speed—many slow are better than a few fast. If bases are numerous, and the machinery good, one-third of the horse-power now demanded will suffice. The present-day attempt to attain in the hampered space of a warship the same speed that can be got with the practically unlimited space of a merchant liner is ridiculous and impossible. It can never be properly done, let trial results be what they may. M. Normand then goes on to discuss the *guerre de course* against England. The *guerre de course*, he says, has two aims: (1) to destroy and ravage the coast, (2) to destroy mercantile shipping at sea. As to the first, he asks, "Can we blockade British ports?" and answers with a decided negative.

As to the second, he draws attention to a new feature of the problem—international trusts. His reasoning works out to a conviction that a *guerre de course* against England would do more injury to neutrals than to England. Pertinently, he asks, How will the neutrals take it? This is a little question that M. Lockroy and his friends ignore. Finally, he argues that only a gross ignorance of this country can lead anyone to suppose that attacks on our commerce will drive us to sue for peace. Rather, says M. Normand, will such attacks be regarded as "pin-pricks," which is his way of saying, spur us to further endeavours. This is quite true; if privateers and the like score successes against us, things would go hard with any who were caught. M. Normand's moral is that to attack England, her ironclads must be met by ironclads. As a builder of torpedo boats, self-interest would dictate quite another doctrine to M. Normand; his taking the line he has is therefore a guarantee that he is speaking his convictions.

The leading article in *Le Yacht* is signed P. L.—initials that we do not recognise or recollect at the moment: most French naval experts have names beginning with "L." This article is a good deal more general than M. Normand's letter, and avoids any definite conclusions beyond remarking with satisfaction that the battleships of the new programme have many cruiser qualities, while the armoured cruisers could be used as battleships, the deduction from which is, we presume, that with the new ships either the best possible *guerre de course*, or a battle of ships of the line, may be attempted with confidence. These careful calculations as to the chances of a successful attack upon us are a curious indication of the trend of thought across the water. We may laugh at shallow pates of the Mercier type; but when thoughtful Frenchmen consider the gist of their remarks, it behoves us to think as well as laugh. Every Frenchman, wise or foolish, seems busy just now in preparing schemes for the destruction of *la perfide Albion*. The destruction, if attempted, will undoubtedly be of the French; but they have brave men and clever officers, who would not die without leaving their mark on us. It is a big ball that Mercier and his gang try to set rolling. No one on this side the Channel can lightly regard a sanguinary war; but it will be a terrible day for France if she plunges gaily into it. She is certainly gay enough now. General Mercier and others of his tribe would never have set afloat their absurd anticipations about relying upon mutinies in our fleet, inability to hit the target, and ships only fit for floating batteries, unless they were sure of an audience of some sort, ready to take their words for such statements. Again we repeat, it is a curious state of affairs.

LONDON WATER SUPPLY.

Last week we drew attention to the proposed action of the London County Council in promoting a Bill for the purchase of the undertakings of the eight London water companies. Just too late to be included in last week's issue we heard the result of an interview which a deputation from the Council had had with the President of the Local Government Board. The object of the deputation had been to enlist the support of Mr. Long in favour of the Council's Bill. The scope of the Bill was unfolded by Mr. T. M'Kinnon Wood, who evidently expected that the Local Government Board were going to take the same view of matters as the London County Council. The anticipations of the deputation, however, were not destined to be realised. Prefacing his reply by the hope that what he was going to say would not cause the deputation to think he was wanting either in courtesy or respect, Mr. Long said he was surprised to learn the action which the Council proposed to take. He remarked that the Government had, last session, decided in no indefinite terms against the Council being the purchasing authority. The change, if there had been any, since their last Bill was discussed, had been still more against the Council. The decision at which the Government had arrived appeared to be, not so much as to matters of detail as to matters of principle, which rendered the Council's action all the more inexplicable. As he read the decision of his predecessor, it was that the Government could not sanction purchase save by a statutory authority. In fact, the deputation were given to understand, as plainly as possible, that the Government practically would not have anything to do with the Council with regard to the question of the water supply of London. On the contrary, Mr. Long remarked that in the next session but one a Government Bill might be looked for. In this Bill he gave it to be understood that the Government would recognise the view of the Royal Commission as regards the constitution of the purchasing authority, that the future management of the water supply of London should be in the hands of a statutory authority representing the whole area, and not one part of the area, however important and overwhelming in its proportion of the area one authority might be. The intentions of the Government, therefore, are fairly clearly defined on this point, and it is difficult to see how the County Council can take any further steps. We advised them to retire when they might have done so with more or less dignity. They have now received the snub direct.

THE UNITED STATES SENATE AND THE NICARAGUA CANAL.

The United States correspondents of the daily Press have made it known that the Senate of the United States proposes the abrogation of the Hay-Pauncefote treaty, and claims that any canal constructed across the isthmus shall belong exclusively to the United States instead of being neutral. The proposition would be amusing if it were not a source of friction between two countries which ought to be closely united, if need be, against the rest of the world, for it is more than doubtful if the canal could be made at all, and it does not exist even on paper at the present moment. The probable cost has been estimated at about £40,000,000. Its construction would occupy from ten to twenty years, and it is by no means certain that an earthquake would not destroy it. The engineering difficulties in the way of the Panama Canal are very heavy, but they are as nothing compared with those presented by the Nicaragua Canal. This fact makes the action of the Senate the more remarkable, for the *casus belli* has no real existence, and probably never will have any. The whole subject is, however, so fully dealt with elsewhere in our pages that we need say no more about it at present. Possibly the situation would be improved if the members of the United States Legislature were placed in possession of the facts.

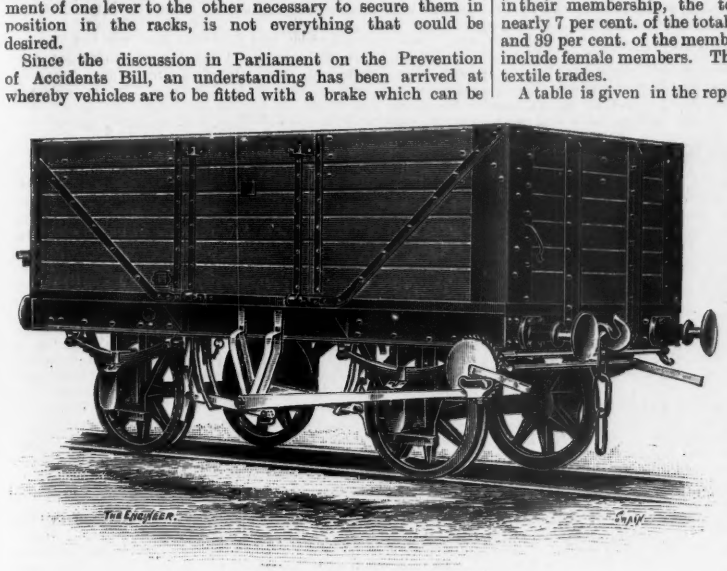
Electrical Engineers from the War.—The detachment from the Corps of the Electrical Engineer—Royal Engineers—Volunteers, which has been serving in South Africa, was welcomed back by the Institution of Electrical Engineers on Tuesday night in Covent Garden Theatre, lent for the occasion by Mr. Frank Rendle and Mr. Neil Forsyth. Replying to speeches of welcome from the President and Major-General Salmond, Colonel Crompton, who has been in command, expressed his thanks for the honour which had been done to the men and to himself by that gathering. The way England had received her sons from the front was sufficient repayment for all they had gone through. He gave some account of the work of the Corps at the front, and incidentally mentioned that the Boer electric projector beside him on the platform was an example of the way in which the wily Boer was taken in by the more wily contractor, who, while supplying what was asked, furnished one much too small to be of any use. He presented a Boer dynamite exploder to the Institution. Captain Lloyd also spoke. Colonel Crompton afterwards showed on a lantern screen a number of interesting views of the work of the Corps in the field.

EITHER-SIDE BRAKE.

THE accompanying engraving illustrates an "either-side" brake for wagons, designed by Mr. H. Pedley, of the Midland Railway Carriage and Wagon Company, Limited, Birmingham. The standard railway wagon brake, as embodied in what is known as the Board of Trade specification of 1887, and which is a modification of the brakes generally employed for a number of years previously, is made with a short spindle, long enough to pass through a pair of V hangers, or brackets, fixed one on each side of the sole-bar, on one side of the wagon, and having a long hand lever on the outer side, with a combined rack and rest for securing the lever in position, and a double lever on the inside, this double lever being connected to push rods actuating the blocks, which are applied to one wheel only of each pair; and it will be seen that such a brake can be applied and removed from one side of the vehicle only.

A long brake shaft extending across the centre of the wagon is objectionable on account of its possible interference with the working of bottom or trap doors, otherwise brakes with a long hand lever at each end of such shaft, and thereby capable of application from either side of the vehicle, are more or less worthy of consideration, although in some cases it is only possible to apply the brake, not to remove it, whilst in others the mechanism communicating the cross movement of one lever to the other necessary to secure them in position in the racks, is not everything that could be desired.

Since the discussion in Parliament on the Prevention of Accidents Bill, an understanding has been arrived at whereby vehicles are to be fitted with a brake which can be applied from either side, in order to avoid the necessity of crossing the line for the purpose of such application, or allowing the vehicle to stand, possibly in an insecure position, without the brake being on to prevent its moving; and though the arrangement does not appear to be so worded, it is only reasonable to suppose that a brake capable of being taken off also from either side will be insisted upon.



PEDLEY'S EITHER-SIDE BRAKE

In view also of the large number of wagons already in traffic, a considerable proportion of which has been built or altered to meet the Board of Trade requirements already referred to, it is clear that to effect any immediate and appreciable change, some alteration should be made in any existing stock having a prospective long life.

The brake we illustrate has been designed with the object of meeting a contingency of this kind, and at the same time complying with the new requirements, as by a simple addition to the ordinary side-lever brake, it is not only made capable of application and removal from either side, but becomes considerably more powerful and effective.

Upon reference to the illustration it will be seen that, a slotted shoe being fixed to the end of the long brake lever, a crank pin and roller pass through the slot and are attached to a disc having a serrated periphery and fixed upon a shaft passing across the vehicle, carried in bearings attached to the underframing, and to each end of this shaft a handle or lever is fixed for working the brake.

There also passes across the vehicle, parallel with this shaft, another light shaft or rod, having a handle at either end for lifting a pawl that engages in the serrations of the disc. These handles are so arranged as to weight the pawl and make it automatic in its action when the brake is being applied, whilst a slight crank in the rod, which comes in contact with the underframing when the handles are lifted, causes the pawl to remain out of gear whilst the brake is taken off. The upward turn in the slot of the shoe secures the brake in the "off" position, whilst the serrated disc provides for a graduated application which is necessary in consequence of the gradual wear of the blocks.

The advantages of the brake are its simplicity and consequent cheapness; the facilities it affords for the ready conversion of existing brakes into "either-side" brakes; and its effectiveness consequent upon the compounding of the levers, which makes it as powerful as the ordinary brake when applied with a brake-stick, whilst at the same time the rack, which has been the source of so much trouble in consequence of damage from capstan ropes and projections, is done away with.

As not infrequently happens, similar ideas have been the subject of separate patents, and we understand that a brake upon similar lines was protected somewhat in front of the one we describe, a slotted lever being employed therein, but the material difference and novelty are in the employment of a slotted shoe attached to the lever, and the provision of graduated application by the serrated disc.

GRADUATED CALLIPERS.—A pair of callipers has just been brought to our notice. It is furnished with a scale which forms part of one of the calliper arms. The other arm is provided with a pointer which traverses the scale. This scale, which is 2½in. long, is graduated to read sixteenths of an inch, and in the sample which has been sent to us the graduation lines are stamped. It is, hence, somewhat difficult to set the callipers with absolute accuracy, though this is a difficulty which could easily be got over by putting the scale on in some other way. It is, however, quite accurate enough for rough work. The registering calliper, as it is called, is made by Tomcox, Limited, of Birmingham.

TRADE UNIONS IN 1899.

THE report of the Chief Labour Correspondent of the Board of Trade on trade unions in 1899 has just been issued. It contains comparative data for the years 1892 to 1899. Much of the report is taken up with figures which, while of considerable value in themselves, are hardly of sufficient interest for us to go deeply into them at the present moment. A short survey giving the general outline of the report may, however, be of use to our readers.

The number of unions on the list of the Board of Trade at the end of 1899 was 1292, which compares with 1218 at the end of 1892. The membership of all the unions at the end of 1899 was 1,802,518, as compared with 1,503,232 at the end of 1892—an increase of 20 per cent. in the eight years. During 1899 the number of unions decreased from 1310 to 1292 chiefly because of amalgamation, but the number of members increased from 1,649,231 to 1,802,518—an increase of 153,287, or 9 per cent. This is the greatest proportional increase in any of the eight years covered by the report. The increase is due to a rise in the membership of nearly every group of trade unions, and those unions which most largely increased their membership were those in the mining and quarrying industries, which yielded an increase of 71,084, or 20 per cent. With regard to the sex of members the returns show that 139 unions include women in their membership, the total number being 120,448, or nearly 7 per cent. of the total membership of all trade unions, and 39 per cent. of the membership of the 139 unions which include female members. The bulk of this number are in textile trades.

A table is given in the report which sets out the membership, income and expenditure, &c., of the 100 principal unions. In the year 1892 these 100 unions had 905,116 members; their income was £1,477,325, or 32s. 8d. per member; and the expenditure £1,436,095, or 31s. 8¾d. per member. The funds then in hand were £1,619,502, or 35s. 9¼d. per member. In 1899 the membership was 1,117,465; the income £1,864,006, or 33s. 4¼d. per head; the expenditure £1,279,506, or 22s. 10¾d. per head; the funds in hand were £3,282,922, or 58s. 9d. This is the lowest expenditure per head since the returns were first made, and the reserve funds are not only greater in total, but greater per head than they have yet been. The increase over 1898 represents 7s. 1½d. The expenditure per head was nearly 6s. less in 1899 than in 1898. The decrease in expenditure in the engineering and shipbuilding group of trades amounted to no less than £168,612, the expenditure in 1899 being £459,147, as compared with £627,759 in 1898.

The average expenditure for "dispute pay" during the eight years is £322,488, or 21·4 per cent. of the total expenditure. In 1899 the expenditure was only £120,728, or 9·4 per cent. In 1898 the percentage was 21·0 and in 1897 33·4 per cent. For unemployed and other benefits, the average for the eight years is £899,441, or 59·8 per cent. of the total expenditure. In 1899 the amount put to the item is £835,259, and it formed 65·3 per cent. of the total expenses. The average of working expenses is 18·8 per cent. of the total. In 1899 the working expenses were 25·3 per cent. of the total, and were as a fact higher than they had previously been.

Mining and quarrying trades furnish more members to trade unions than any other branch, though the number of actual unions in these is small. There are in the mining and quarrying trades 60 unions with 424,783 members, or 24 per cent. of the whole. The metal, engineering, and shipbuilding trades come next. They have 272 unions and 331,245 members, or 19 per cent. of the whole. The building and textile trades come next, a good way behind in point of numbers. The railways have 68 unions and 163,283 members. Out of the 1292 unions 614 are registered and 678 are not registered; but taking membership into account, it is found that the members of the registered unions form 78 per cent. of the total of all the unions. The proportion of men in the classes from which trades unions are drawn who actually belong to trades unions is, roughly, one in five; or, omitting agriculture, in which branch of trade the proportion of trade unionists may be almost disregarded, one in four. In the case of women in factories and workshops, the proportion is rather more than one in ten. The funds of the unions are almost entirely derived from direct contributions from the members. The average rate of contribution in 1899 amounted to 30s. 7¼d. per head. The amount paid by the members of different unions varies considerably. Thus in 45 societies, with a membership of 422,963, the average contributions per member in 1899 were less than £1; in 33 societies, with 388,511 members, they ranged from £1 to £2; in 12 societies, with 167,390 members, from £2 to £3; and in 10 societies, with 138,601 members, from £3 to £4. The income from other sources than contributions only represents some 10 per cent. of the whole. It is interesting to find that nearly a third of this 10 per cent. is made up of fines, entrance fees, &c. The total income of the 100 chief unions for the eight years under discussion was £13,735,769. The following table shows the disposition of the funds at the end of 1899. It will be seen that the greater part was so held as to be readily available in cases of emergency. This amount was nearly all deposited in the banks, Post-office Savings Bank being most generally used. Only a small portion consisted of cash in the hands of branch or central officers:—

	£
Deposited in banks and cash in hand	1,637,060
Invested funds:—	
Corporation and public trust stock	656,285
Railway stock	175,565
Freehold and leasehold property	133,346
Mortgages	141,343
Trading firms	41,114
Building societies	13,011
Loans	1,836
Disposition not shown	283,362
Total	£3,282,922

MINERAL PRODUCTS OF THE UNITED STATES.

THE following table of the quantity and value of the mineral products of the United States for the calendar year 1899 is taken from an extended table prepared under the direction of the United States Geological Survey:—

Products.	1899. Quantity.	1899. Value.
METALLIC.		£
Pig iron (spot value), long tons	13,620,703	49,034,530
Silver, coining value, troy ounces	54,764,500	14,161,325
Gold, coining value, troy ounces	3,437,210	14,210,680
Copper, value at New York City, lb.	585,342,124	20,833,180
Lead, value at New York City, short tons	209,240	3,766,320
Zinc, value at New York City, short tons	119,408	2,746,400
Quicksilver, value at San Francisco, flasks	30,454	290,549
Aluminum, value at Pittsburg, lb.	5,200,000	343,200
Antimony, value at San Francisco, short tons	1,275	50,375
Nickel, value at Philadelphia, lb.	22,541	1,713
Tin, lb.	none	none
Platinum, value (crude) at San Francisco, troy ounces	300	360
Total value of metallic products	—	105,443,617
NON-METALLIC (SPOT VALUES).		
Fuels—		
Bituminous coal, short tons	193,321,987	33,587,061
Pennsylvania anthracite, long tons	53,944,647	17,628,426
Natural gas	—	4,004,975
Petroleum, barrels	57,070,350	12,920,781
Structural materials—		
Brick clay	—	2,250,000
Cement, barrels	14,311,407	2,883,411
Stone	—	8,947,315
Abrasive materials—		
Corundum and emery, short tons	4,900	30,120
Garnet for abrasive purposes, short tons	2,765	19,865
Grindstones	—	135,117
Infusorial earth and tripoli, short tons	4,631	7,406
Millstones	—	5,623
Oilstones, &c., lb.	—	41,656
Chemical materials—		
Borax, lb.	40,714,000	227,976
Bromine, lb.	433,004	21,420
Fluorspar, short tons	15,900	19,320
Gypsum, short tons	479,235	257,416
Marls, short tons	60,000	6,000
Phosphate rock, long tons	1,515,702	1,016,815
Pyrites, long tons	174,734	108,650
Salt, barrels	18,356,503	1,501,837
Sulphur, short tons	4,830	21,500
Pigments—		
Barytes (crude), short tons	41,894	27,905
Cobalt oxide, lb.	13,230	3,702
Mineral paints, short tons	63,111	145,680
Zinc white, short tons	40,146	642,336
Miscellaneous—		
Asbestos, short tons	681	2,368
Asphaltum, short tons	75,085	110,800
Bauxite, long tons	35,280	25,119
Chromic iron ore, long tons	none	none
Clay (all other than brick), long tons	—	250,000
Feldspar, long tons	27,202	45,709
Fibrous talc, short tons	54,655	87,630
Flint, long tons	37,852	46,269
Fuller's earth, short tons	12,381	15,929
Graphite, lb. { Crystalline, lb.	2,900,732	33,421
Graphite, lb. { Amorphous, tons	2,324	
Limestone for iron flux, long tons	6,707,435	939,041
Magnesite, short tons	1,280	3,696
Manganese ore, long tons	9,935	16,456
Mica, lb. { Sheet, lb.	108,570	14,117
Mica, lb. { Scrap, tons	1,505	6,178
Mineral waters, gallons sold	39,562,136	1,189,606
Monazite, lb.	350,000	4,000
Ozocerite, refined, lb.	none	none
Precious stones	—	37,154
Pumice stone, short tons	400	2,000
Rutile, lb.	230	206
Soapstone, short tons	24,765	66,161
Total value of non-metallic mineral products	—	89,558,172
Total value of metallic products	—	105,443,617
Estimated value of mineral products unspecified	—	200,000
Grand total	—	195,201,789

INSTITUTION OF ELECTRICAL ENGINEERS.—An Address was given last week before the Manchester section of this society by Mr. Behr upon his proposed mono-railway between Liverpool and Manchester. He proposed to run the trains at an average speed of 110 miles per hour, and he calculates that the energy necessary to obtain that speed would require on a train weighing about 45 tons a maximum of 1500 horse-power. That power would require 2000 horse-power in the central station, and they estimated that the gradients of the line would require between 450 and 500 horse-power, or about 700 horse-power in the central station. As there would always be a ten minutes' service, with two carriages starting—one from Liverpool and one from Manchester—and two carriages running on the line, the total power required at the central station would be 5400 horse-power. If they provided 50 per cent. for contingencies and breakdowns, a total power at the central station would be required of about 7500 horse-power. The voltage at the central station would be probably between 12,000 and 16,000.

GLASGOW UNIVERSITY ENGINEERING SOCIETY.—A Lecture was given last week by Mr. Shrapnel Smith, the hon. secretary of the Liverpool Self-Propelled Traffic Association. The lecture was entitled "Automobilism up to Date," and was illustrated by lantern slides showing the development of the motor carriage from the earliest record. Mr. Smith urges the use of motor vehicles for three chief reasons: First, it will relieve the horses of hard drudgery, which, in Liverpool, means an average of six to seven tons for two horses. Their uses need not decrease the number of horses in use for light service. Secondly: The horse being as long as a vehicle, removing the horses is equivalent to doubling the street area. Thirdly: The low cost, which is about 5s. per ton per day with full load for thirty to forty miles. In comparison with oil and steam-driven conveyances the lecturer did not favour electrically-driven motor cars under existing conditions, excepting when economy is not a consideration and where current is available. He knew of no cell which after six months' use did not lose 50 per cent. of its capacity.

POWER GAS AND LARGE GAS ENGINES FOR CENTRAL STATIONS.*

By Mr. HERBERT A. HUMPHREY, Member, of Northwich.

DURING the next few years the design and erection of large central power stations for the generation and distribution of electric energy in bulk promise to be the most important and interesting problem with which mechanical engineers in this country will have to deal. The new stations will not only be larger than any now existing, but every possible effort will be made to reach a degree of economy in the production of power, such as will surpass any previous results.

Central station work in this country, so far as magnitude of the undertakings is concerned, is undoubtedly behind when compared with American and continental practice; but the future development promises to be on an unparalleled scale, as indeed it must be if the rapidly-growing requirements for lighting, traction, and general power purposes are to be met. Although it is not probable that in the next few years London, for instance, will be able to show the enterprise of New York, which has in hand the construction of three power stations, where in each case the maximum capacity will exceed 70,000 horse-power, yet London has its 20,000 horse-power station at Bankside, its 10,000 horse-power at Deptford, and its 7000 horse-power at Willesden, also several stations running the latter rather close. Then in the provinces, Manchester is erecting its 100,000 horse-power station, which, if carried to completion, will leave Edinburgh, Liverpool, Glasgow, and Brighton, which are the next largest, a long way behind.

There are, however, some schemes for supplying electricity "in bulk," recently considered by a Select Parliamentary Committee, which may be the beginning of even greater things; and it is to be hoped that the short-sighted policy of municipal authorities will not be allowed to interfere with the progress of a movement destined to become of national importance.

The sale of electricity in Great Britain is now over one hundred million Board of Trade units per annum, or three times what it was four years previously. The capital expended in electric supply undertakings already exceeds sixteen million pounds sterling, and the capital outlay for electric traction is even greater; yet at this moment the number of miles of electric tramways under construction in Great Britain is fully equal to the miles of route already in operation. Last year eighty-nine provisional orders for electric lighting were granted. Electric railway and tramway Bills and tramway provisional orders numbering forty-six received the Royal Assent; also applications for twenty-one light railways to be worked by electricity were received.

These facts point to great additions to our central stations, but it is neither for lighting nor for tramways that the real bulk of the energy will in the approaching future be required, but rather for manufacturing purposes. When electric energy can be generated and distributed at such a cost as to displace the use of the steam power plants now operating in manufacturing works, the inauguration of a new era of centralisation in the supply of power will have commenced, the importance of which cannot be over-estimated. The average total cost of a unit of electricity generated by electric-supply undertakings in this country for 1898 was 2·81d., of which the expenses of generation amounted to 1·79d. With improved load factors this figure would be less; but those who know the actual cost of steam power generated on manufacturers' premises will appreciate how much this figure must be lowered, if the manufacturers are to be induced to take electric energy in bulk from outside companies. It is known that several companies will, under certain conditions, supply electric energy for power purposes at 1d. per unit, this being possible because of the higher price paid for lighting current; but even this figure is too high for manufacturers who would require large currents. In an appendix, the author has tabulated the approximate cost of power under different circumstances, and from these figures it becomes clear that, unless the price is reduced to something like ¾d. per unit, only the smaller manufacturers will benefit by the wholesale adoption of current for power purposes supplied from central stations.

Where, then, is this cheap supply of electric energy to come from? In this country we have not the Niagara Falls with their 7,000,000 horse-power to draw upon, or even the 600,000 horse-power of waterfalls said to be available in Switzerland, and it is certain that we must rely on the coal supply as the only cheap source of power available in really large quantity. It is the object of the present paper to inquire into the question of the use of power gas and large gas engines as a factor in the solution of the cheap power problem.

The central stations which have so far adopted power gas and gas engines in this country are comparatively few and small. Of a total of seven stations the largest has an aggregate of 650 horse-power, and the largest unit in use is 200 horse-power. The reason for this state of things may be easily summed up. In the first place, until recently no gas producer was commercially available which could make a reliable gas sufficiently cheaply or from any but expensive fuel, such as anthracite or coke; and, secondly, no gas engines of large size had been in use for a sufficient period of time to satisfy electrical engineers as to their suitability for working under station conditions. These reasons exist no longer, for there is in the Mond producer plant the means of converting cheap forms of bituminous coal or slack into a clean gaseous fuel, suitable in every way for use in gas engines, and at the same time recovering the ammonia of the coal as a valuable by-product. The net effect is that the fuel cost per unit of electricity generated is, including all cost of labour, repairs, &c., at the gas producer and recovery plant, less than one-twentieth of a penny per unit at the switchboard. This figure represents the cost under actual conditions of continuous running at Winnington, without allowing full credit for the sulphate recovered.

Secondly, gas engines of 500 horse-power are already numerous, and one of 650 horse-power has been at work over a year, while others of 1000 and 1500 horse-power are building. The author has been on the Continent and in America with the special object of studying the question of large gas engines, and has had the opportunity of seeing the easy comfortable way in which the 650 horse-power Westinghouse engine does its work. Mr. George Westinghouse told the author that the Westinghouse Machine Company had sufficient experience to make them feel quite confident of their ability to build 2000 and even 3000 horse-power engines, and run them with perfect success.

The special features of gas engine practice, which have enabled gas engines to be made of powers far beyond those formerly thought possible, may be briefly stated. The most important is the improvement in the design of the cylinder liner, the piston, and the valves, whereby they may all be efficiently water-cooled; and probably a time will soon come when no engine of more than 17in. diameter will be constructed without a water-cooled piston and a high degree of compression. The better shape given to the clearance space, the disposition of the valves in this space, the introduction of induced and positive systems of scavenging, and the better understanding of the causes of pre-ignition, have all aided in the forward progress of the gas engine, and a noticeable strengthening up of all working parts has taken place. Thus the Westinghouse practice is to make the crank shaft half the diameter of the piston, and in larger sizes even more. For example, with a 34in. piston the crank shaft is made 19in. diameter. Improvements in the breech-end castings, better arrangements for the contraction and expansion of the metal, improved means of ignition, and items of this nature are too numerous to mention, but all help in marking a step-by-step progress in the attainment towards gas engines of great power.

In another appendix particulars of some large gas engines are given. Two further appendices contain the data the results of a trial of a 400 horse-power Crossley gas engine carried out by the author. Here it is shown that the normal load trial of this engine gave a consumption of 60 cubic feet of Mond gas per hour per indicated horse-power, equivalent to a thermal efficiency of 26·2 per cent. The gas was measured by a large station wet meter of 50,000 cubic feet per hour capacity, erected specially for the experiments, and in another appendix the author has enumerated the precautions taken to ensure great accuracy in all the measurements of quantities involved in this trial, and in the other experiments recorded in the paper. Indicator diagrams of the Crossley engine, with their isothermal and adiabatic curves, together with the equations to the actual expansion and compression curves, are given in the paper, but are not reproduced here. Other diagrams show how large the fluid resistance may become in a big engine, especially if the governor is cutting out explosions so that the suction stroke takes air only. The length, size, and arrangement of the various pipes have considerable effect on the bottom-loop diagrams, and these matters are worth careful study in each individual case.

It was anticipated that the large Crossley engine would give fully 30 per cent. thermal efficiency; but the makers have kept down the degree of compression to so low a figure that the average effective pressure is only a little above 60 lb. per square inch. Although this engine has to run at full load day and night, this extreme measure of precaution would be quite unnecessary if the pistons were water-cooled. However, it is the first engine of its size Crossley Brothers have made, and they are to be congratulated on having turned out a workmanlike and successful engine. More economical results are expected from the 500 horse-power "Premier" gas engine, which unfortunately was not delivered early enough for the tests to be carried out, and the results included in the present paper. This engine, when tested at the Premier Company's works at Sandiacre, with Mond gas, showed a mean effective pressure of 103 lb. per square inch, but there were no means of accurately determining the gas consumption. It is expected that 650 horse-power will readily be obtained from this engine, which is now one of the largest two-cylinder engines in existence.

Though Mond gas is a most perfect fuel for gas engines, there is another ideal fuel which, unfortunately, is not found in this country. The use of natural gas in the Pennsylvania and other districts of America has given a stimulus to the employment of gas engines in the United States, but in a comparatively few years' time the present sources of supply of this gas will be practically exhausted. The figures of a brake trial for a Westinghouse gas engine using natural gas, as abstracted for the author from the books of the Westinghouse Machine Company, when he had the pleasure of looking over their carefully-kept records, are given. These figures show the excellent economy of over 24 per cent. thermal efficiency, calculated on the brake horse-power and in a comparatively small engine. The system of governing by controlling the quantity of gaseous mixture of constant quality has been well worked out in Westinghouse engines, but is really only applicable to the case of a rich gas. It was stated that in the large engines a consumption of 9 cubic feet of natural gas per brake horse-power hour had been reached, and there are hopes of lowering the record to 8 cubic feet with the 1500 horse-power engines.

America, France, Germany, Belgium, and lastly England, are now turning out large gas engines, and the author has information to show that the orders for large gas engines exceeding 500 horse-power collectively amount to over one hundred engines. With such results before us, the time has certainly arrived for a careful study of the advantages to be gained by the adoption of a combined Mond producer plant and gas engines; and the subject may be considered under the following headings:—The possibility of using cheap fuel, and of recovering its ammonia. The greater economy of gas engines as compared with steam engines. The simplicity and reliability of gas engines. Gas producers better than steam boilers. Costs.

Mond gas.—The first of these headings has been the subject of Dr. Mond's experimental work on gas producers started in 1879, and carried out on a large scale for a number of years at Winnington, Cheshire. This work resulted in the solution of the difficult problem of converting the cheap forms of fuel into a good gas of uniform quality, in such a way that the ammonia existing in the fuel is not destroyed, but recovered as a by-product.

Each Mond producer of the ordinary size used at Winnington is capable of gasifying 20 to 24 tons of slack per day of twenty-four hours, and the volume of gas furnished from one ton of fuel fed into the producer varies from 140,000 to 160,000 cubic feet, according to the quality of the slack, and is sufficient to develop 2000 indicated horse-power hours when utilised in a gas engine. The value of the sulphate of ammonia recovered from one ton of fuel is, at present prices, 8s. naked at the works.

In appendices and tables are given the most recent figures relating to the Mond producers as worked at Winnington, where the gas is used for a great variety of purposes. These figures show the analysis of the slack used, the gas made, and the ashes drawn from the producer; also weights, specific gravity, yield of gas, calorific values, air required for combustion, specific heats, and other figures; in fact, all such information as will enable an engineer to make any calculations he may require in adopting the plant for central station work.

(*To be continued.*)

* The Institution of Mechanical Engineers.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

NAVAL ENGINEERS.

SIR,—There are some points in your leader of 16th inst. on the above subject on which I should like to make a few comments, if you will allow me, after which I propose to deal with the remarks of "Fidley House" in his letter published in THE ENGINEER of 23rd inst. Given the choice of the two lines of service on board our war vessels, that of the deck officer, executive, or line officer, as the Americans call him, would no doubt be the one nine out of ten engineers would elect to serve in, at least after they had had experience of the subordination and disabilities which service in their own line entails on them. As usual, in arguments on this question, the ever-present social stigma attaching to engineers takes the first and prominent place in your leading article. It is not, however, a question of superior social status as such in the executive, for, as you point out, in the American navy both classes of officers are originally trained alike, and they are, I believe, recruited as a rule from the same social classes. In our own Navy, too, the social superiority of the executive line is not one which they can lay general claim to apart from the social position which their rank as naval officer confers upon them. A study of Burke's "Peerage and Landed Gentry" and other similar publications in conjunction with the Navy List will show that, with the exception of a very small percentage, the executive officers have no claim to superior social status over their brother officers in the civil branches. Naval social position is quite unique, and is altogether independent of any claims to exclusiveness based on civil prerogative. The social exclusiveness of the naval executive officer is entirely naval, and has been handed down to him by the traditions of the service, the manners and customs of generations of naval officers, and is at the present time one of the dominating forces which mould the mind and character of the budding naval officer during his course of training in the Britannia as naval cadet. Any one who knows our naval officers will recognise this fact. They are amongst the last of people to put on airs on the basis of their social position outside the service, but the whole bent of their minds is against the slightest infringement of the hard-and-fast rules of conduct which would endanger in any way their social prerogative as the naval executive. They look on the Navy and all its honours and privileges as their heritage, to be held absolutely and inviolably their own. It is a singular thing that this class prejudice—for it is nothing else—is backed up by the public and the Press alike, yet no doubt in many respects it is a good thing, and proves that the man who thinks highly of himself will, as a rule, gain the high opinion of other people. The engineers object only that this should be the prerogative of the executive officer alone. Why should not the prestige attaching to the naval officer be shared also by him, when he is socially, intellectually, and educationally at least equal?

It is an extraordinary and painful fact that engineers are the very first to cry down their own profession; they cannot bear for anyone who calls himself an engineer to pretend to pose at the same time as a gentleman. In our large engineering firms the same spirit is shown; capable engineers of large experience are passed over, and the highest positions in the firm are given in many cases to retired naval officers, or even to private gentlemen without any engineering knowledge whatever to start on. The whole gist of your article tends to unduly depreciate the importance of mechanical skill and talent; and the fact that a staff of fairly-educated superior mechanics would be sufficient to keep in order and efficiency the complicated machinery of our battleships is held to debar the highly-educated and trained engineer, who has to advise and direct them, from claiming the title of "gentleman." At least this is the impression left on one's mind. Would you deny him the social status to which his rank as naval officer should entitle him, in common with his *confrères* in the executive line? Do you really think that the engineering department in our warships should be without a properly qualified officer and gentleman to represent it, and that all the important mechanism of the ship, and three-fourths of her hull, should be without a representative engineer of more importance than an ordinary skilled mechanic? No; although "Fidley House," and some who think with him, may hold this view, the last clause in your article saves the position. "Let the engine-room work be done, from first to last, by a highly-paid crew of very competent, practical men, with warrant rank if necessary, under the control of an officer who might be termed lieutenant or captain of engineers, ranking with the executive, and as highly trained as we please," &c.

Now, this embodies what the large majority of naval engineers want. It is the solution of the problem to which all the efforts and the progress of the class has been directed, only they want to ensure that this captain or lieutenant of engineers is himself an engineer, not a naval executive officer without any engineering training or instincts pitchforked into the position over their heads, to the permanent degradation of the engineering profession, both in the Navy and outside it. This is the *crux* of the whole position, and here lies the danger, that the naval engineer may find himself robbed of his birthright at the very instant when he thinks he has reached the goal. Let us have your powerful support in preventing this danger, and we are all with you. We do not want more engineers, but the very best obtainable. This statement of our views will cover most of the field traversed by the arguments of "Fidley House," who weakens his case by manifest unfairness to us and ignorance of the capacities of the engineering staffs of our battleships. He is strongly afflicted with this fatal obliquity of mental vision to which I have already alluded—the incapacity to see any importance whatever in the performance of the onerous, dangerous, and highly important duties necessitated in keeping in order and efficiency the complex machinery and boilers of our warships. The challenge thrown out by "Fidley House" is rash and absurd, but I will gratify him by replying to it.

Watch-keeping at sea is not by any means considered the most important duty of our young engineer officers. "Fidley House" must know that most of these young officers are simply in training for the time when they themselves will have sole charge of a ship. I have for my staff here in a first-class modern battleship one senior engineer of eight years total service, and 28 years of age, and five others, the oldest of whom is 25, and the others ranging from 22 to 24, with from two to four years' service. One of these young officers has to inspect the whole of the hull below the water-line, with the 48 separate compartments of the double bottom, quarterly; and see that all is kept clean and in good condition, with all their sections and pipes, sluices and drain valves, with the pumping and draining fittings; and the sea cocks and flooding gear of all the magazines. Another has charge of all water-tight doors and their fastenings—over 300 in this ship, not counting 96 manhole doors on double bottoms—all fans and fan engines, 10in. automatic valves—about 60—louvres, and other ventilating valves and fittings. Another has to look after the two capstan and steering engines, with all their gear; boat-hoisting engines, coal whips, four steamboats, fire main with all its cocks and valves, all of which gear is in constant use. Another has the hydraulic pumping engines, with all their pipes and valves for working guns and turrets; ammunition hoists, and all their gear; shell-room and loading rammers, recoil presses, &c.; half-yearly examine the mountings of all the 6in. and smaller guns; keep in order 17 Whitehead torpedoes, full of delicate mechanism; four submerged tubes and their gear; four sets of triple air-compressing machinery, with reservoirs, charging columns, and fittings; and three 600-ampère dynamo engines and machines. Another has to keep all the books and store accounts, and look after all telegraphs, tell-tales, and indicators, helm signal gear, &c. The senior engineer is responsible to me for the whole of the main machinery and boilers, forced-draught fans, fire and feed pumps, fresh water condensers, distillers, evaporators, &c., and general supervision. All this work these young officers do, and do well, with only twelve skilled mechanics to look after the whole and do repairs under them. What mercantile engineer of the same age would care to have the same responsibilities, and in addition muster his men at divisions, be responsible that they are in all respects clean and well dressed and their kits complete! It must be remembered that eight or ten of these 15,000-ton battleships are constantly being manœuvred at steam tactics within two cables of each other at speeds varying from 10 to 14 knots. If the slightest thing were to go wrong with the engines, telegraphs, controlling gear, or steering engines at such times a frightful disaster would almost certainly be the result. What is there in the steaming condition of an ocean liner which in any way resembles this?

I must apologise for this long letter, which could easily be made longer, but I feel that engineers in the Navy should have the support and sympathy, and not the abuse and misrepresentation, of the whole profession outside, and this I am certain they would have if the nature of their duties and the conditions under which they have to carry them out were more fully understood.

December 18th. FLEET ENGINEER, R.N.

SIR,—Your correspondent "Mercantile Chief" shows a singular want of grasp, and proclaims a very low ideal for the profession of marine engineering. Because he has taken a vessel across the Atlantic, and had charge of a warship's engines, the assumption is made that his solely practical knowledge is all that is required on board ship—a liner or a man-of-war. Probably an intelligent greaser who had served under him and made two or three voyages in the ship could—successfully too—steam her from port to port. As well say that, as I have known, an ex-bluejacket can pilot one of Armstrong's cruisers down the Tyne, or a collier's skipper navigate his vessel to the Brazils, that the educational standard required of the navigating officers is quite unnecessary. While the keynote "educate" is being sounded by Lord Rosebery and others, that England may keep her place among foreign competitors, "Mercantile Marine" thinks differently.

By all means let us have practical men; but, Sir, the engineer officers of the Navy are practical men, they go through a higher class and a longer course of instruction than in the merchant service. In addition they have a sound theoretical training. To say that education makes a man afraid to soil his hands is, in these days, absolutely untrue. Has "Mercantile Marine" ever seen a gunnery lieutenant after a day at coaling ship, an engineer officer

after examining his boilers, or the officers of a torpedo boat destroyer after a week on a rough sea? And I have yet to find an officer who was ashamed of his condition.

Thoroughly to carry out the various duties of the engineer officer, not only of the Royal Navy, but of the mercantile marine, with the ever-increasing and complicated machinery, the supervision of hundreds of men, and to get the best results both from the machinery and men, it is necessary to have a highly-educated officer, and a gentleman.

With regard to the new *personnel* scheme of the American navy, I was speaking a short time ago to an executive officer, who had been in the Oregon during the Spanish war. He informed me that this new arrangement was necessary, and right in principle, but required a few adjustments, such as the introduction of a senior engineer officer, and a few minor alterations. The engineer had no difficulty in quickly picking up the deck duties, but the executive took far longer to master the intricacies of the steam department.

In conclusion, my opinion is that in the evolution of the naval officer, the two who will survive are the gunner and the engineer, the one to fight the ship, the other to keep her in fighting trim, but both executive in their own department. ENGINEER.

Maida Vale, W., December 5th.

WATER SUPPLY.

SIR,—Your readers will note with much interest the description of the Malvern Water Company's meter supply in THE ENGINEER of November 23rd. Water by measure was adopted there for the reason that the supply had run short, and it became compulsory that the drastic measure of supply by meter should be immediately put into force, until new parliamentary powers could be obtained. Water by measure was not instituted for the purpose of increasing the revenue, and Mr. Maybury has not explained whether the charge of 1s. per 1000 gallons, and 8s. per annum meter rent, has been sufficient to pay the total expenses. If the works were owned by a company, probably a dividend could not be earned. Water engineers will be benefited by the perusal of the description of one town in England solely supplied by meter; the interchange of opinion as to the apparatus in use, size, description, and number of meters employed, will help other small towns to initiate a similar system. My experience would not lead me to use ¾in. or ⅝in. meters. I believe the whole of the ⅝in. meters once used at Manchester have been discarded. The original question raised was "the relationship between the cost of water wasted and the cost of detection." At Malvern the whole of the services are metered, waste-water meters are used to prevent waste, and the output from the filters is accurately measured also by large meters, and I presume the consumption is 25 gallons per head per day for domestic supply, but we are not informed at what cost per 1000 of the population this result is obtained with the most modern, the best apparatus, and recording instruments. For making useful comparisons we should know the consumption for street watering and sewer flushing.

Rate per head has no meaning when comparing one town with another. The circumstances and conditions of each town must be fully explained, otherwise the statements made may be very inaccurate and misleading. We are promised by the British Association of Waterworks Engineers a stereotyped form on which to record accurate general information, in order that all the facts and figures may be tabulated by a perfect system for ready comparison. The information will be supplied by members of the association, therefore it will be fully guaranteed, and help to solve the various questions mooted in this discussion. Will Mr. Maybury kindly explain if Malvern is a water-closet town entirely? Is a two-gallon flushing cistern used? or have the Water Committee given way to the sanitary authority allowing the use of a three-gallon apparatus?

I take it that all the meters are owned by the Urban District Council, and that they are all fixed in the pavement, and kept in repair by this authority. Although the result is highly satisfactory, yet when we know all the circumstances and compare with well-regulated and similar towns, the statement of facts and general results, does not induce one to revert to the sale of water for domestic puposes by measure. The practice of removing meters and washing and repairing them on the pavement at a cost of 6d. per meter will not commend itself to the distributing engineer who does not control the use of the public thoroughfare. If this peculiar meter requires to be constantly removed for washing out and cleaning, &c., it does not compare favourably with the positive meters which have stood the test and proved their durability. It is quite as economical to change a meter and take it to the shop for repairs as it is to wash and fettle it up *in situ*. My experience has shown that the best make of positive meters will run for three years without cleaning, and measure water of a uniform hardness of 18 deg., registering with extreme accuracy all the time. It is not sufficient to take a meter out on the pavement and wash it. If the instrument has done any work at all it should be taken to the shop, placed on the test tank, and tested at the pressure that it usually works at.

Mr. R. C. Frain, in your issue of November 30th, has put the question of the prevention of waste of water very clearly when he says, "The engineer should be supported in his endeavour in a whole-hearted manner, and empowered to take proceedings in all flagrant cases of wilful waste and neglect. Such a practice would have equally as good an effect as fixing a meter on every service. The rules and regulations provided by most water companies, if rigidly enforced by law, would check a large proportion of the waste. The Acts of Parliament have allowed penalties for wilful waste by the consumers, viz., leaving the taps running day and night to flush drains, leaving the hose running all night, and fixing automatic flushers direct on the main, contrary to the regulations. The fine allowed by Act of Parliament should be strictly enforced for all such waste."

I cannot agree with your correspondent when he says there is no check on the night inspector's work. Take a town of 60,000 inhabitants; three night men will stethoscope every service in a fortnight, working their districts with regularity, and bringing in their reports every morning. It will be seen by the recording gauges whether the work is being done efficiently by the pressure keeping up to its normal height; but if the men are withdrawn from the night work, the leaks will increase and the pressure gradually decrease. If a "loafer" was employed he would be readily detected, as his district report sheet would show his neglect of duty. The comparison of report sheets and recording gauge diagrams being made every morning, the experience thus gained is sufficiently accurate and clear to enable the detection of any dereliction of duty, and is a thorough check on dishonest night workers.

From the diagrams of the pressure recorders, or the Glenfield water-level recorders as used at Rochester, most valuable information may be gained, and if comparisons are made daily the recorders will be found to be the pulse of the supply. We have read much of the method of preventing waste by the use of the stethoscope and by the use of waste meters, but the system of detecting waste by what is known as the "hammer test" has never been described, and a word or two as to its merits would be valuable. Mr. Frain has removed the house cisterns from all houses, as was done in the East End of London, but the East London Water Company has thereby been taught a severe lesson. The loss of storage cisterns was the cause of great trouble to the company now seeking powers to compel the owners to replace the cisterns.

A cistern formed as the "Simplex," which is simply an enlargement of the service pipe, must be taken as a satisfactory storage. In my case the tenant of nearly every house, however small, takes in lodgers, and sometimes repairs of mains, services, &c., have to be executed, often taking three to four hours; and without cisterns and a proper water supply these houses cannot be said to be in a satisfactory sanitary state, and would not meet the medical officer of health's requirements in any modern health resort—see leading article, THE ENGINEER, August 20th, 1898, and December 9th, 1898.

Mr. Frain has not replied to the question as stated in Mr. Jenkins' paper, viz., "the relationship between the cost of water wasted and the cost of detection and prevention of waste." I find the cost per 1000 of the population is given in several instances in THE ENGINEER of July 27th and August 10th. Mr. Frain states that 5½d. per 1000 gallons is the price obtained for water sold in his town. What price is it considered fair to allow for water saved by the use of his waste meter system? B. A. W. E.

December 18th.

TEST OF A FERRANTI ENGINE AND DYNAMO.

SIR,—I have pleasure in giving herewith the results of a steam consumption test made on a 300-kilowatt steam alternator supplied recently by Messrs. Ferranti, of Hollinwood, to the order of the Cardiff Corporation.

The figures are sufficiently good to interest, I believe, several of your readers, and the names of the gentlemen who conducted the tests are a guarantee of their reliability and accuracy.

The plant comprises a vertical compound condensing engine, having cylinders 18in. and 34in. by 18in., with an alternator of Ferranti's well-known copper armature type between the high-pressure and low-pressure engines, the whole designed to give 300 kilowatts, 2500 volts, by 120 ampères, 40 periodicity and 200 revolutions per minute. The valves are of the gridiron type, driven by cam-gear, the governing being effected by a throttle valve, and there is forced lubrication. The alternator drives its own exciter.

The test was made on November 8th, 1899, there being present on behalf of Messrs. Ferranti, Mr. M. Longridge, Mr. A. B. Mountain, and Mr. Gillett. On behalf of the Cardiff Corporation there were Mr. H. R. J. Burstall and Mr. Llewelyn B. Atkinson. The test was started at 9.15 a.m., and continued at full power until 4.12 p.m.

The steam from the engine was discharged into a surface condenser which only received the steam of this engine. The air pump discharge was measured by being run into two barrels, one being filled while the other was being emptied, each being filled up to a mark. During the trial sixty-nine pairs of barrels were used, making a total of 53,030 lb. The next day a test was made to ascertain whether the condenser was tight, and it was found a leak equal to 1 per cent. existed, making the total water used 52,500 lb. It was found that 92 lb. of water had collected in the drain sump under the engine, having escaped from the glands, which has to be added, making a final total of 52,592 lb. The duration of the trial being 6·95 hours, the quantity of steam used by the engine was 7568 lb. per hour.

The vacuum, as measured in the exhaust pipe close to the engine, was 18·7in., or 9·2 lb. per square inch. The alternator was run on a water resistance, the power was measured by a number of ammeters and volt meters, one of each being chosen after comparison with a Kelvin watt balance as being the most accurate, and readings were taken every fifteen minutes. There was also a Thompson recording volt meter, which was read every thirty minutes.

Each of the instruments read during the trial was sent to the Board of Trade Laboratory immediately after the trial for calibration, and the necessary corrections have been made in the calculations. The mean output of the alternator was 315 kilowatts, and the mean horse-power shown by the indicator cards was 499, at the mean speed of 204·9 revolutions per minute as got from the engine counter.

The combined efficiency of the engine and alternator, taking the above figures for electrical output and indicated horse-power, was 84·6 per cent. Taking the figures actually obtained, the steam per kilowatt hour was 24·03 lb., being practically 2 lb. below that required by the specification.

I think this is very good, and if the vacuum had been 26 or 27in., the result of course would have been materially better. No special preparations were made to prepare the engine for this test. The steam was not superheated, and supplied from boilers of the dry-back marine type.

Electricity Department, Cardiff, December 11th. N. APPELBEE, Electrical Engineers.

VENTILATION.

SIR,—I have read with interest the letter of your correspondent Mr. William Ingham, published in your 30th November number, and note that good ventilation has resulted from his chimney-draught system, results having shown 8 parts per 10,000 of "the rich steams of sweet humanity." Was the experimenter the only occupant? I have quite dismissed in my own mind the possibility of any but a mechanical ventilation system ever satisfactorily dealing with the problem of public ventilating and warming, and when your correspondent lapses into the suggestion of hospital work by the furnace system, I cannot but believe he is ignorant of the conditions to be provided for. Why not leave ventilation to the properly-qualified ventilating engineer? Let the medical officer of health, the architect, the consulting, ventilating, and warming engineer work to the mutual benefit of mankind, and more pleasant buildings will arise here in England as they have sprung up in the United States, and almost everywhere on the Continent. Of course here in this naturally atmospherically-filthy city of London, one gets acclimatised to either hot or cold, and we delight in sitting through a play at the theatre in a semi-football-league condition of moisture, but then our Irvings, our Terrys, our Trees, are so good that we ignore the presence of the toxic poisons and the tiny but potent bacteria which also play their parts in life's comedy of errors.

There cannot be a better system of warming and ventilating than the plenum system of downward ventilation, forcing air in near the ceiling at a low velocity, and mechanical extracting near the floor also at a low velocity. Just think what it means! All the dust, the product of the pulverisation of shoe leather, is carried rapidly away, and the upper part of our dwelling places and rooms becomes a reservoir of fresh warm air, gradually descending to be discharged near floor level. For public buildings, electric fans or air-propellers and steam heaters may be used. For private houses, electric-air propellers and hot-water heaters. In infectious diseases hospitals, where sometimes as much as 5000 cubic feet of fresh air per hour has to be supplied, for not only carrying off, but diluting the pathogenic bacteria, and where cubicles for each patient are sometimes used, anything but a mechanical system is totally inadequate. The extraction air, rich in parasitic organisms, may be actually cremated, and so destroy the germs of diseases and their spores as well. Mr. Ingham's remarks as to draught are really very amusing; ventilation itself is derived from the Latin *ventus*, meaning a wind, and no two people born into this world alive agree as to draughts—there is no better anemoscope or draught indicator than a bald head! A carefully-designed mechanical plant need not annoy even the fortunate possessor of such a distinguishing mark of thought; so nine years spent at this branch of civil engineering has led me to think.

67, Finsbury Park-road, London, December 5th. R. GORDON MACKAY, Assoc. M. Inst. C.E.

ENGLISH AND AMERICAN RAILWAYS.

SIR,—I deeply sympathise with your correspondent, Mr. P. Howell, F.S.S., in his complaint of English railway statistics, the shortcomings of which he has indeed greatly understated.

In the first place, the official return of the total number of passengers is quite incorrect, a through ticket over two or more lines scoring one for every line traversed. The anomaly of this becomes apparent when it is remembered that a passenger from Euston to Edinburgh counts as two, while he who books at King's Cross for the same destination counts as three. As all through tickets are handled and the fares apportioned at the Clearing House, it would be perfectly simple for that institution to supply the figure to be deducted, but they do not, and so the return is too high. It is also too low, much too low, no attempt being made to take into account the journeys of season-ticket holders. It would be easy to do this with fair approximation. Some such estimate is, moreover, essential to any attempt to measure the work done by our trains. The "number of season tickets" is a perfectly useless and meaningless item of information; in fact, the whole English system of railway statistics is a scandal and a disgrace to a civilised country, and will never be of real use until re-modelled on the basis of the ton-mile and passenger-mile units.

In comparing American and English railways, it should be borne in mind that our suburban traffic is in magnitude quite unparalleled in any other country. In America local passengers are carried mainly by electric tramways. There are not wanting signs that this will ultimately be the case in this country, and our main lines so be freed for through fast trains. I look forward to the time when our expresses will run as the Atlantic city flyers, and with their punctuality, and our fares correspond with those of, say, Belgium—but that time is not just yet.

C. M. WATES.

47, Westbere-road, West Hampstead, N.W., December 15th.

THE VICTORIA NYANZA.

SIR,—In one of the local newspapers here I see an extract from your paper in which it is stated that the area of the Victoria Nyanza Lake is 27,000 square miles, or upwards of 81,000 million square yards. This lake has but one inlet, I believe, and the question I would beg to submit for consideration is, could not the crest of this inlet be raised by 1 or 1½ yards, so that some 100,000 million cubic yards of water could be very economically stored in such a natural reservoir? The expense of such a project cannot by any possibility be very great; at all events, its investigation is well worth considering, for if water can be stored in this manner in the Victoria and Albert Nyanzas, a more abundant supply would be secured for the whole valley of the Nile. On the Godavery works all the weirs are supplied with shutters a yard high to keep up the water; these shutters can be raised or lowered by common screw gearing, and are easily worked by a couple of Lascars. If any floods occur during the rains the shutters are raised, inch by inch, as required to pass off the flood waters, and then lowered to keep up the waters in the canals, the length of weir having been determined, so as to keep the level down to 3ft. as much as possible. It appears to me that some such plan could be adapted to these great African lakes, and there would then be no occasion to go to the enormous expense of constructing great dams across the main streams of the Nile, and I think you will allow this suggestion to appear in your valuable journal. People at home are becoming alive to the importance of storing water in such countries as South Africa and India, and Egypt offers so fine a field to begin upon, from its proximity to Europe, it is to be hoped that this great suggestion of the late Sir A. Cotton's will soon be fu..y worked out there.

Bungalore, Madras, November 20th. GENERAL R.E.

[No studies have been made with regard to raising the level of the Victoria Nyanza, although the possibility of doing this has been vaguely suggested.—Ed. E.]

THE EFFICIENCY OF FANS.

SIR,—In referring me to the article by Dr. Lodge in your issue of January 4th, 1889, "P. W." is strongly supporting my theory regarding the action of the diverging pipe. For I find that Dr. Lodge expressly states that the pressure of the air is less at the throat than at the large end of the pipe, and, further, he proves mathematically in a particular example that the pressure at the latter point must be 2½in. of water greater than that at the throat.

Now the surprising feature is that, having arrived at this fact, Dr. Lodge failed to follow the matter to its logical issue by demonstrating that as a consequence of this diminished pressure or partial vacuum, the atmospheric pressure must at once come into action and assist the fan. All the observed facts and all the known practical results are entirely consistent with this theory; and, moreover, there is no other or rival theory which is in any way supported by those facts and results.

If perchance "P. W." can set forth any such rival theory, it will be far more conclusive than his mere denial of my facts and contentions, and I shall be pleased to give it every consideration; but it is essential that any arguments he may advance must be obtained from, or be based upon, the results of actual experiments, as are the whole of my statements. W. A. GRANGER.

Brooke-road, Stoke Newington, N., December 17th.

SIR,—In further reference to this question, permit me to refer Mr. Granger to an interesting illustrated report on the trial of a Guibal fan, published in THE ENGINEER for November 22nd, 1878.

December 18th. P. W.

LEVELLING STAFF.

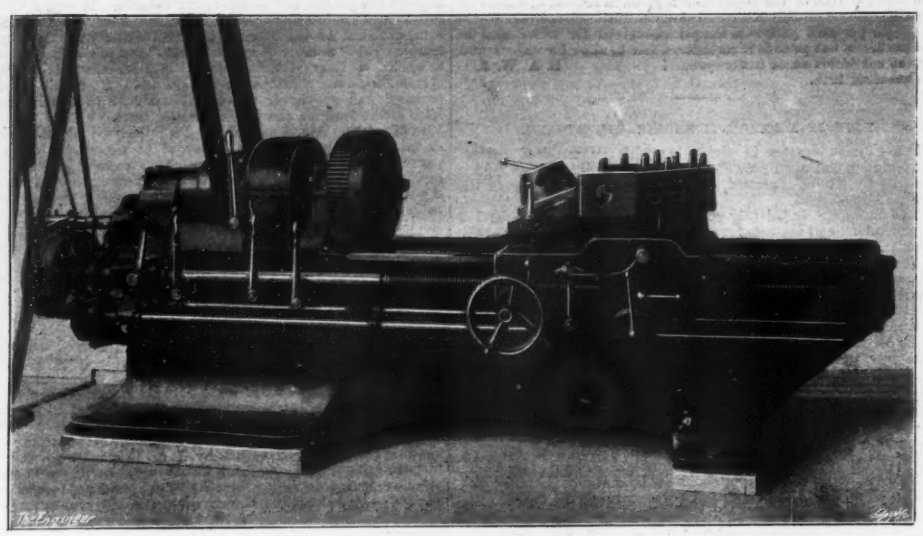
SIR,—Your correspondent Mr. Herdman says in his letter on this subject that "much can be said in favour of the Scotch staff." After thirty years' experience of the "Sopwith," and also knowing well the Scotch staff, the only advantage I can see that the latter possesses over the former is its cheapness—of course a great consideration.

December 14th. J. GOULD.

HOSE ARMOUR.—A specimen of a new form of armour for india-rubber hose has been sent to us by Wallach Bros. It consists of a plaited tube of narrow steel tape. There are sixteen strands in the sample before us, each about 2 mm. wide, and very thin. The strands are well galvanised to prevent rusting. It is suitable for a pipe about 1in. diameter outside, and we should imagine would be found very efficient. We understand that a variety of sizes is made. It reduces the flexibility to a certain amount, but not sufficiently to be prejudicial in most cases.

BETHNAL GREEN FREE LIBRARY.—The Committee appeal at this season on behalf of the institution, which has now been in existence about twenty-five years, situated in a densely-populated East-End parish of 130,000 inhabitants. Bethnal Green is the seat of many industries, but one-room homes and extreme poverty prevail to a great extent. The main library consists of a fine collection of books, and in the general reading-room these are made use of by large numbers, who enjoy no facilities whatever for reading at home. As manufacturers abound, care is taken to afford opportunities for the acquisition of technical knowledge which would otherwise be quite inaccessible to such readers. A lending section has been added to the main library, and this attracts a large and ever-growing number of readers. Free lectures and concerts, courses of which are given every season, are also much appreciated by thousands of hearers. Evening classes for learning languages, music, shorthand, first aid, &c., are growingly popular. The institution is supported entirely by voluntary contributions, which are most urgently needed, and may be sent to F. A. Bevan, Esq., treasurer, 54, Lombard-street, E.C.; to the bankers, Messrs. Barclay and Co., Limited, same address; or to the Librarian at the Bethnal Green Free Library, London, E.

SEMI-AUTOMATIC TURRET LATHE



THE CONRADSON SEMI-AUTOMATIC TURRET LATHE.

This turret lathe, of which we give an illustration above, is an entirely new departure from conventional types of machines for chuck work. It has been designed to take exceedingly broad and heavy cuts, and though it is heavier and stronger than existing machines, the physical exertion required to handle it has been reduced to a minimum, all the movements being actuated by power. The chief feature of the machine is the exceptional size of the turret. The lathe is made in two sizes, viz., 24in. swing and 40in. swing; on the 24in. machine the turret is 2ft. 6in. diameter, and on the 40in. machine 4ft. This large diameter and the form of the tool holders allows the turret to operate right up to the work, and so avoids the overhang and consequent loss of rigidity — one of the weak points of ordinary turrets. It also allows the lock bolt to be placed at a much greater distance from the centre of the turret, thus reducing the leverage between it and the cutting edge of the tool. The turret is automatically clamped around its outer edge by a powerful combination of screw and wedge, binding the turret perfectly solid. This clamping movement, being automatic, requires no attention on the part of the operator, and the turret consequently is always clamped while under cut. The lock bolt is of large diameter, and is forced into steel-bushed index holes by a powerful cam. On one side of the main turret a cross slide is provided, which carries as a tool post an auxiliary hand turret; this slide is furnished with a screw for traversing by hand and also with an automatic feed in either direction. The main turret is moved along the bed in either direction at a high speed by means of the quick pitch screw shown in the front of the bed; this movement is used in bringing the tools up to their work before the feed is thrown in, and also in running back after a cut. When run back the turret is revolved automatically at any desired point of its traverse. The feeds of the main turret and the cross slide are actuated by strong frictional gearing with an arrangement giving four rates of speed in either direction without alteration of gear. Stops are provided for the main turret, by means of which the feed movement of each tool can be disengaged automatically at any point—an arrangement which permits of tools of greatly varying length being employed. The headstock is provided with double-frictional back gearing in connection with compound-reducing gearing, giving two back gear speeds and four quadruple gear speeds for each step of the cone pulley. Any of these speeds can be put in operation without stopping the machine, thus enabling the operator to obtain the correct cutting speeds without loss of time. The levers actuating the gears are interlocked, thus preventing any two ratios of gearing being thrown in at the same time. In connection with the double-friction countershaft twelve different speeds can be obtained from each step of the cone pulley—thirty-six speeds in all. The lowest back gear ratio is 5 to 1, and the maximum ratio is 96 to 1, thus giving ample power for using broad shaving tools, or compound turning tools having any desired width of cutting edge.

The lathe is made by the American Turret Lathe Works Company, of Wilmington, Del., U.S.A., and is being introduced to this country by their agents, Markt and Co., Manchester, and Pfeil and Co., London, E.C.

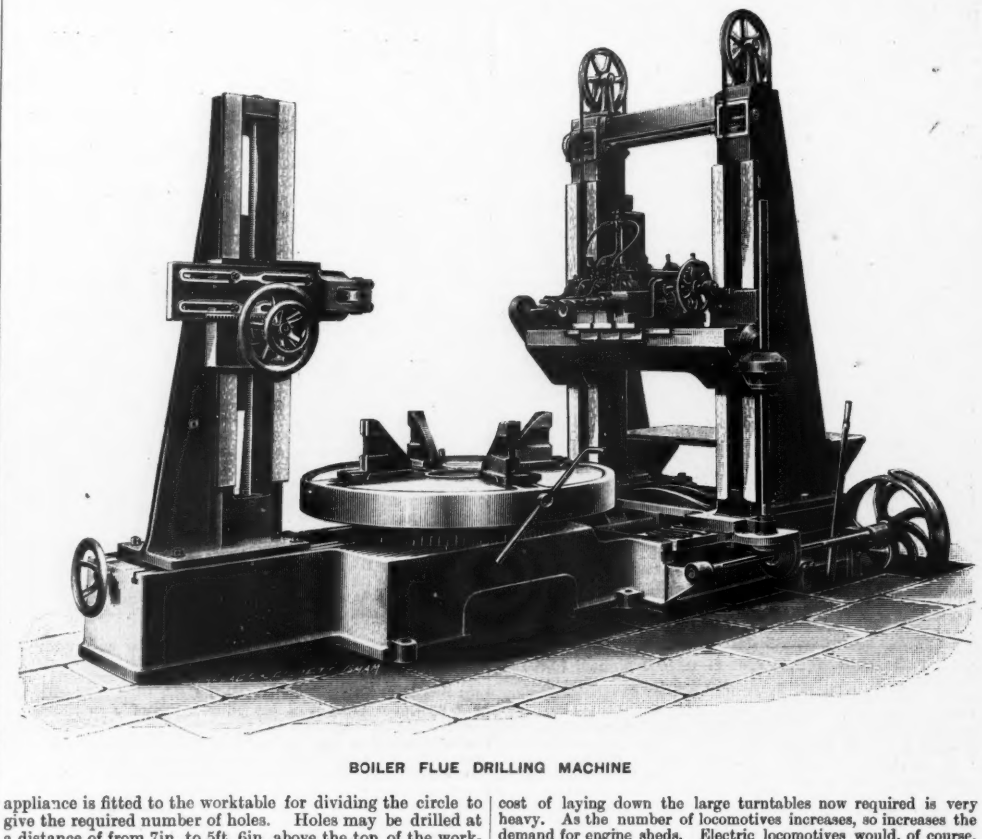
H.M.S. Cressy.—The armoured cruiser Cressy, having completed her three contractors' trials, left Plymouth last week for progressive steam trials under Admiralty directions and supervision. The Cressy is one of a new class of six armoured vessels now under construction, and was the first to leave the contractors' hands. She was built and engined by the Fairfield Shipbuilding Company.

Royal Institution.—The following is a list of the arrangements for Friday evening meetings of this Institution before Easter.—January 18th, Professor Dewar, M.A., LL.D., F.R.S., M.R.I., "Gases at the Beginning and End of the Century." January 25th, Adolphus William Ward, Esq., Litt.D., LL.D. (Master of Peterhouse), "Some Aspects of Seventeenth Century Pietism." February 1st, the Right Rev. Monsignor Gerald Molloy, D.D., D.Sc., "Electric Waves." February 8th, Professor G. H. Bryan, Sc.D., F.R.S., "History and Progress of Aërial Locomotion." February 15th, Professor J. J. Thomson, M.A., Sc.D., F.R.S., "The Existence of Bodies smaller than Atoms." February 22nd, Sir W. Roberts-Austen, K.C.B., D.C.L., F.R.S., M.R.I., "Metals as Fuel." March 1st, Henry Hardinge Cunynghame, Esq., C.B., M.A., M.R.I., "Enamels." March 8th, W. A. Shenstone, Esq., F.R.S., "Vitrified Quartz," with experimental illustrations. March 15th, not at present arranged. March 22nd, Horace T. Brown, Esq., LL.D., F.R.S., M.R.I., "Some Recent Work on Diffusion." March 29th, the Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., Sc.D., F.R.S., M.R.I.

BOILER FLUE DRILLING MACHINE.

The boiler flue drilling machine illustrated below is of special design. It has three spindles carried on a horizontal balanced slide, which is raised or lowered by hand-driven bevel gear. The two outside spindles are adjustable together horizontally to any pitch from 1¾in. to 2½in., and are provided with swivelling adjustment, so that they may point truly radial for any diameter of flue. The centre spindle is fixed to point to the centre line of the flue, but is capable of final adjustment.

Each drill spindle is provided with a self-acting feed motion and quick return motion by hand, each being independent of the other. All three spindles can also be fed or withdrawn simultaneously. The circular worktable is provided with four jaws, all moved together by a screw and central bevel gear, so that it forms a large self-centering clutch. It will take flues from 2ft. up to 4ft. 6in. diameter. A dividing



BOILER FLUE DRILLING MACHINE

appliance is fitted to the worktable for dividing the circle to give the required number of holes. Holes may be drilled at a distance of from 7in. to 5ft. 6in. above the top of the worktable. A back stay, with vertical and radial adjustment, is fitted to a stout column. The base for the whole machine is 15in. deep, and the total weight is 7¼ tons. The machine has been completed recently by the Britannia Company, Colchester.

The Bridges Committee of the London County Council are recommending the Council to rebuild Lambeth Bridge. In 1887 Sir Benjamin Baker advised that, unless the authorities were prepared to accept the gravest responsibility, there was no alternative but to increase the stability of the bridge. Upon this advice certain repairs were effected. Iron gates have been provided at each extremity of the bridge to close it on emergency, and the Council has considered it necessary for it to be watched day and night. The Committee recommend the Council to build a granite-faced concrete five-arched bridge. The chosen type is the same as that of the bridge now being erected at Vauxhall. The total approximate cost, including maintenance and painting when required, is £308,000. The clear span in the centre will be 158ft., and the headway given will be 20ft. above Trinity high-water mark.

ON THE SUPERSESSION OF THE STEAM BY THE ELECTRIC LOCOMOTIVE.*

By W. Langdon, Vice-president.

(*Concluded from page* 600)

Water.—The steam locomotive calls for £28,573, or 0·211d. per train mile; electricity, £17,066, or ·0522 per train mile—a difference in favour of the latter of £11,507. It is difficult to attempt a comparison between the cost of a largely-scattered supply—water pillars at numerous stations—and a concentrated one—one to every fifty miles or so of line. The site for such a generating station would naturally be selected with a view to cheap water supply, and, as a rule, no great difficulty would attend its selection. A further point to be borne in mind is that, naturally, all machinery would be of the most modern and economical type, and that the working would reach the highest ideal for an electrical plant, viz., an actually constant and perpetual demand.

Drivers.—It it quite clear, whatever may be the cause of the existing heavy charges, it will apply equally to electric as to steam locomotives. The engine must stand by its train, and the men along with it. Any reduction that may be effected will be in the mode of dealing with the traffic. The present condition, viz., that of a mixed traffic travelling at various rates of speed—one class of train being required to make room for another of a more important character—is not destined to effect economy in this branch of expense.

Repair and renewal.—I have assumed that the cost of repair and renewal would be practically one-fifth less with electricity than steam. I think I am more than justified in this. The wear and tear of stationary engines or motors cannot possibly be so great as that of the steam locomotive. The number of electric locomotives would necessarily be as great, but their wearing parts would be immensely less than those of the latter. Many local units would be entirely dispensed with.

Oil and stores forms a somewhat large item in the running expenses of the steam locomotive. Much of this is for the lubrication of moving parts which would be non-existent in electric engines. Moreover, with stationary engines it is possible to recover and again use a great portion of the lubricant employed. It would appear that considerable economies in oil should accompany the employment of electricity.

We may now perhaps glance at possible economies on that which is indispensable for the steam locomotive, but which is unnecessary, or not so largely necessary, with electricity. Water pillars, turntables, engine sheds, coal stages—all these are expensive items which with electricity are either not required, or capable of considerable modification.

Water pillars, supplemented in many instances by fixed engine-power for pumping the water into reserve tanks, involving power-houses, sheds, and other structures, form part of all large stations and many other points at which the locomotive requires to take water. With electricity, water to any extent would be required only at that point at which the central generating station is placed. If this station served fifty miles of railway, then it would take the place of all the pumping plants, water pillars, &c., otherwise required throughout that section for the steam locomotive. Every pumping station involves the provision of labour, fuel, &c. All water pillars require special attention during hard weather. Economies in first outlay and annual charges on this account should accompany the use of electricity. Turntables would be unnecessary. The annual outlay for repairs in this respect is not great, but the cost of laying down the large turntables now required is very heavy. As the number of locomotives increases, so increases the demand for engine sheds. Electric locomotives would, of course, need housing as well as the steam locomotive, but the space which they would occupy would probably be about half that now required.

Wherever we find an engine shed, there we see an area of land covered with coal; lines of rails applicable thereto; coal stages to which the coal has to be carried, and from which it has to be distributed to the locomotives. First the coal has to be stacked, then loaded into trucks and carried to the coal stage; and thence weighed and placed on the engine's tender. This is the course of procedure at each engine depôt. If we compare it with the work of a large central station, such as that sketched out in this paper, I think it will come home to us that although the work would be large, it could not be nearly so large as at present. If stacking were at all necessary there would be the less quantity to stack, and it would all be dealt with in a more concrete form and at comparatively few centres. Again, in this respect there is reason to look for economies in land, in buildings, and labour.

All these are assets directly due to the employment of electricity. Others, not considered in the figures which I have advanced, would, with its presence, be available; the lighting of the trains, stations, goods warehouses, and yards, marshalling grounds, &c.; signalling, to some extent, might become automatic; while at large centres

* Institution of Electrical Engineers, read November 29th, 1900.

where signal-boxes have become both numerous and cumbrous, it would appear but reasonable that, with the aid of such a power, points and signals might not only be actuated, but the means for operating them might be so condensed as to admit of the entire duties being embraced within such a space as would enable one man to deal with them. Labour and space would be economised, and less time would be occupied in giving effect to the various operations than is possible with the existing means. To this we may add that obviously it would also provide for the operation of lifts, and other local demands for power which at present have to be met by isolated plants.

Let us now turn to what may perhaps be regarded as difficulties to be encountered.

The first question that will arise will be:—Are we safe in placing so many of our eggs in one basket? With the steam locomotive we have a travelling unit which has to manipulate its own load and is in no way responsible for the duties of others. If it breaks down, the inconvenience is chiefly confined to the vehicles it is hauling, and in due course they are extricated from their difficulty by the aid of another engine.

With electricity we are locating our power at one spot in so many miles of line, and if that breaks down that section of line is practically dead. But with the usual spare parts—the duplication, if necessary, of the generating units—there should be no reason to anticipate such a failure. The same argument in a measure applies to the power at the distributing stations. Here, however, the case may be met not only by duplication, but by, in emergency, connecting one section through to its neighbour. For the time being inconvenience would be felt; speed would be reduced, but traffic would not be stopped. Of all this we have evidence in that which has already been done. We see railways being worked, tramways operated, and other large undertakings all dependent upon one large and central source for their life and being. Electric railways have become an accomplished fact, and we may turn to those that are in use as exponents of success or of difficulties to be encountered.

Does the magnitude of the question we are considering—the eventual supersession of the steam by the electric locomotive—remove it from the category of that which has so far been done? I think not. The basis is there. It is to-day in useful operation. Improvements will come. The mode of working which we see to-day may, and probably will, be simplified, but this will only strengthen that which has already been accomplished.

Still, there are points of great interest for consideration. As a rule, that which has been done has, with one or two exceptions, been confined to underground lines, and these exceptions have not as a rule dealt with such heavy work as the large overland railways require to compass. Overground railways have to work through all kinds of weather—rain, snow, fog—and at times to pass over rails submerged in water. Winter floods are not unusual in certain localities of nearly all overland railways. These are conditions which will affect the construction of the locomotive, the arrangement of the current collector and the contact-rail, and are subjects for thought not only in themselves but in relation to the mass of under-gear which now appertains to all passenger railway stock, as also to the relative position and construction of roads, their repair and renewal.

A question may here intervene whether a similar economy would attend the operation of small branch lines of railway where the trains are few and far between? Consider! Why are the trains so few and far between? The traffic is, we will say, a fixed quantity. There are only so many tons of goods and so many passengers passing over it daily. The steam locomotive is available only at certain times, and to attain economy it is necessary that so many trips only should be made. The accommodation is limited to this. But if the power for working the trains were constant, although reduced, any number of trips might be made. The additional cost would be that only of the driver, for the rest the branch would be no more costly, while the frequency of the communication would tend towards the development of the district, and the consequent increase of trade.

I have now, I believe, fairly set forth the salient features of this question. The data which I have produced speaks greatly in favour of electrical energy as a motive power for the movement of railway trains. The economies which it would apparently effect are, indeed, so large as to raise a doubt whether my deductions—whether the figures I have adopted—are fair and reasonable. It must not be forgotten that my calculations are based upon a mileage run clear of stoppages or other contingencies. Stoppages are unavoidable. They will arise, and provision must be made to meet them. But I find it difficult to identify them further than I have already done. Stoppages will not affect the coal bill. I have taken the present cost of drivers and firemen to apply to that for drivers and assistants for electric locomotives. My allowance for repair and renewal of machinery will, I think, be generally supported. Necessarily the subject has to some extent had to be dealt with more in the abstract than in detail, but I venture to hope my figures will not be found illiberal. We must not lose sight of the fact that the conditions are a constant load and continuous output for every hour of the year. I believe the cost of shunting at stations and in goods yards may be met by the economy attending the use of a cheaper coal than that which is necessary for the steam locomotive; but assuming that some provision should be made for this, for administration and contingencies, I conclude that 20 per cent.—say, £50,000—of the accredited saving will cover it.

We thus bring the net annual advantage to approximately £208,124, and if we deduct interest on the primary outlay it will further reduce it to £191,674. Whether it is, in face of the savings to be effected in engine sheds, coal stages, water cranes, &c., fair to make a debit in full of this amount, I must leave those who are interested in the question to determine. Broadly, it appears to me to mean this—that were a new company to start with electricity as their motive power, they would not need to take into consideration the interest on the entire additional outlay, because they would save a great portion of it in other directions.

But were an established company to adopt it, they would already have incurred the cost for the lands, buildings, &c., and the expense for establishing electric working would unavoidably prove to them for some years an addition to their capital charges.

Although I feel that my reason for pursuing such a course will be obvious, it may be desirable that I should emphasise the fact that my sole object in availing myself of the data afforded by Mr. Johnson's presidential address to the members of the Institution of Mechanical Engineers is that I might deal with data extending over a long period of years, rather than draw a comparison with a period which might be regarded as possessing some abnormal feature. It must, however, be noted that recent figures tend to greatly magnify the result. I have shown that, with electrical working, certain economies are to be anticipated. The annual amount of these economies is based upon the ascertained saving per train mile, multiplied by the average annual mileage for the twenty-four years—viz., 32,485,580. The mileage for 1899 is 45,453,438, and the expenditure £2,006,069, as against the twenty-four years' average £1,122,899; and the train mile cost has risen to 10·59 as against 8·943d. Assuming that the saving per train mile remained the same—it would probably be larger, consequent upon the increased cost of coal—the resultant saving would be, independent of any deductions for interest or contingencies, £364,006.

Large as is the apparent economy thus presented, it would, were it possible to employ a gas plant for so large an output, be increased by the use of the "Mond" gas system. Such a system would appear to invite consideration, at all events for smaller installations, as, for instance, for the operation of branch lines.

Here it may perhaps be asked: What good can attend the production of these figures, or the results they advocate, seeing that the railway system generally is wedded to the steam locomotive? Is it probable that any railway company will cast on one side their present equipment for the purpose of taking up that, which, although holding out fair hopes of a large economy, is yet, in a measure, or in the large measure to which it would have to be applied, mainly an untried agent? To this I reply: Railway companies are under the direction of business men—men who know the value of money. Satisfy them that economies are to be effected—and do not let us forget that the economies are not confined solely to those with which this paper has dealt, but probably to many others indirectly associated therewith—and that the economy embraces a reliable means of working, and they will not be found undesirous of testing its worth. The life of a steam locomotive is not an indefinite quantity. Its replacement by one of more modern construction or of greater power, quite apart from its ultimate destruction by wear and tear, is an appreciable fact. As traffic increases, so additions have to be made. We see so many new engines ordered year by year. What is to prevent a railway company, instead of thus perpetuating its annual costs, setting apart portion by portion of their system for operation by electrical energy, and, instead of ordering for, say, that portion of their system, steam, to order electric locomotives; and thus to bring, piece by piece, their entire system under electrical operation? No sane railway management would do otherwise, and I assume that, should my figures stand unrefuted, no railway company would desire to follow any other course. Prove its economy, prove its reliability, and there is nothing in the fact that railways are, for the time being, the slave of the steam locomotive, to militate against their supersession by electrical energy.

That this paper deals with a problem which, sooner or later, will force itself upon the attention of all who are interested in railway progress, few will be disposed to dispute. So far it has been considered solely in the realm of economical working—in the interest of the railway shareholder. But are we justified in looking at it only from this standpoint? Does it not embrace a question of still greater magnitude? Is it not one of even national interest? If, by the aid of electricity, we can save no less than 18·876 lb. of coal per train mile, it is clear we could save no less than three million tons a year* if all our railways were worked by that agency.

View it again from still another standpoint. Twenty thousand locomotives moving about throughout the land cannot fail to leave their mark behind them. Our railway stations, the telegraphs which traverse the railway routes, the trees which grow on its borders, all bear evidence of their presence. The supersession o the steam locomotive by the electric locomotive will bring with it a purer and a more cleanly atmosphere, cleanly railway stations, cleanly railway carriages, a higher and a purer sanitary condition of life.

THE INSTITUTION OF CIVIL ENGINEERS.

SIGNALLING ON THE WATERLOO AND CITY RAILWAY.

AT the ordinary meeting on Tuesday, the 11th December, Mr. James Mansergh, president, in the chair, three papers were read, entitled, "The Signalling on the Waterloo and City Railway," and "Note on Signalling Outlying Siding Connections," by Mr. A. W. Szlumper, M. Inst. C.E., and "Signalling on the Liverpool Overhead Railway," by Mr. S. B. Cottrell, M. Inst. C.E.

The Waterloo and City Railway, as previously described in the "Minutes of Proceedings" of the Institution (vol. cxxxix.), was an electrically-worked underground railway 1½ miles in length. It was a double line, in separate tunnels, with a station and accommodation for shunting the trains at each end. Trains ran every six minutes, the journey occupying about six minutes. There were two signal cabins, one at Waterloo and one at the City, the former containing sixteen levers, and the latter eighteen levers. The line, however, was practically divided into two block sections by the provision of signals about half-way between the stations, such signals consisting of an electric lamp fixed to the wall of the tunnel, electrically controlled from both boxes and by clearance bars or treadles. In addition to the ordinary mechanical interlocking, the Sykes electric lock-and-block system had been largely introduced, and as a further safeguard slipper bars were fixed a short distance in front of the more important signals by means of which the current to the electric motors was automatically cut off should a train pass the slipper bar when the signal is at danger. The starting signals at the stations had double arms, the upper one being a right-away signal, the lower one being a draw-ahead signal. Both these arms were worked by the same lever by means of a Sykes electrical selector. The stop signals at the stations consisted of ordinary ground discs, which were also provided for shunting movements. Treadles or fouling bars were extensively used; they consisted of an angle bar about 35ft. in length, balanced on pivots and connected to a contact-making switch. In lieu of the ordinary repeaters, bells were fitted in the signal boxes which rang when any signal failed. This was effected by passing a wire through a series of signals by means of contact makers on each signal and upon their corresponding lever in the signal box, terminating in a bell which started ringing should any contact be broken. Facing-points were fitted with ordinary facing-point bolts, also Sykes' electrical point-detectors, one being fixed to each stock rail on a pair of points and connected to and working with the tongues. Both tongues had to be dead home before the selector was operative, and until then the point lever was locked by an electric lock. The block instruments used were Sykes' lock-and-block instruments, which were electrically interlocked with the levers and signals. All the lights in the signals and discs consisted of 8-candle power glow-lamps in duplicate, and were repeated in the signal-boxes by pilot lights.

The second paper described some modern methods of electrically controlling outlying siding connections. One system described was applicable to a railway where an electric lock-and-block system was installed. The siding connection was controlled by a key, the removal of which, from an instrument, locked up all conflicting signals and broke down the block instruments until the key was returned; no outdoor signals at the siding were necessary. Another system described consisted of the provision of a ground-box and outdoor signals at the siding, locking instruments being provided at both the section and siding boxes. When the siding was to be used, the switching in of the siding-box locked up the starting signal at the section-box by means of an electric lock, and released an electric lock on the siding-signal, the switching out of the siding-box restoring the section-box signals and instrument to their normal condition. A special feature of this scheme was electrically locking up the entrance to the siding-box from the section-box. Another system described consisted of the provision of a ground-box and of outdoor signals at the siding connection. When operations were to be carried out at the siding, the box was switched in as a section-box, and electric locks on the signals were released; during shunting operations, the siding-box was treated as a section-box, and when completed, the box was switched out, and the signals again became electrically locked from the section-box.

The third paper described the system of automatic electric signalling in use on the Liverpool Overhead Railway, which, originally promoted to facilitate passenger transit to and from the docks, had developed into a line nearly seven miles in length, and, in addition to fulfilling its original purpose, provided rapid access to Liverpool from two important suburbs, and by means of an electric tramcar system owned by the company from other suburbs. When the line had been originally constructed as a dock railway with many stations, automatic electric signals had been introduced, in order to avoid the expense of men and maintenance, but with the extensions in the suburbs the automatic system had had to be supplemented at termini and junctions by ordinary mechanical signals. The intermediate stations were divided into fourteen block sections; each block had a station at its commencement, and since the length of the blocks was short, each station was equipped with only four signals, viz., one home signal and one starting signal for each road, the starting signal being practically the distant signal for the station in advance. A train leaving a station passed the "breaking" contact, putting the starting signal to "danger;" it then passed the "making" contact, which pulled off the home signal of the station it had just left, and the starting signal of the station in the rear. The circuit between the making contact and the other signals was made through a switch fixed on the arm of the starting signal, so that should the latter fail to go to "danger," the circuit could not be completed, and the line behind would be blocked. The making and breaking contacts were actuated by a striking board fixed on the last coach, so that should a train break in two, the signals would not be operated. This automatic arrangement applied to all intermediate stations, and where the automatic system merged into mechanical, the alteration took place at the home signal in one direction, and at the advance starting signal in the other, that was, on the up road the advance starting signal was the first automatic signal, and on approaching the termini the distant signal was the first mechanical one. The current for working the signals was supplied from accumulators at 50 volts pressure; two sets of twenty-seven cells were situated at each station, and these were charged in series from the generating station. These accumulators also provided light to the stations. The expenditure of electric energy in current was very small. Each station comprised four signals, each worked with a lowering current of 5 ampères at 40 volts, and with a holding current of 0·25 ampère at 40 volts. With a three-minute service for twenty hours a day each signal would be lowered 400 times, requiring therefore 2000 ampère-seconds, or, say, 0·5 ampère-hour, per signal per day. The entire station would require 80 watt-hours per day, and the total system 1040 watt-hours. This, however, did not include the holding-off currents. Assuming each signal to be held down 1½ minute, it would be down 600 minutes per day, requiring 150 ampère-minutes, or 2·5 ampère-hours, or five times as much as for lowering. In the first few months there had been occasions of signals failing to go to danger, but experience enabled such failures to be eliminated, and reduced the number of other failures, which now amounted to an average of only 1 in 14,156,857 operations.

* 396,241,265 train miles × 18·876 lb. = 3,339,040 tons.

THE INSTITUTION OF JUNIOR ENGINEERS.

AT the meeting of this society, held at the Westminster Palace Hotel on 14th December, the chairman, Mr. Percival Marshall, A.I. Mech. E., presiding, a paper on "The Metallurgy of Tin" was read by Mr. J. H. Davy James, member, of Swindon.

In briefly reviewing the history of the subject, the author remarked that tin was without doubt one of the articles of commerce of the Phœnicians, who obtained it from Britain and from that part of the British Isles now known as Cornwall and Devon. Several charters were given to the Cornish mines, and in the reign of Edward I. the Stannary laws were instituted, some of which are even now in force. England enjoyed the monopoly of the tin trade up to the eighteenth century. In the early part of that century tin was discovered in Bohemia and in the island of Banca. Minerals of tin are fairly widely distributed over the earth's surface, being found in the Malay Peninsula, Australia, United States, Mexico, Chili, and Brazil. Europe contains workings at Saxony, Austria, Gallicia, and Vauby in France.

The chief mining district in England lies between Truro and Land's End in Cornwall, the most important mine being Dolcoath, which is now 600 fathoms deep, and employs 1500 hands. Although retaining a great deal of old-fashioned plant, it has kept well up to date, and now possesses effective batteries of Californian stamps, and about forty Frue Vanners for dressing the ore.

The chief ore of tin "tinstone," $Sn\ O_2$ sp. gr. 6·9, is found in regular veins or lodes, and also in alluvial formations. The author described some of the appliances peculiar to Cornish tin-mining, viz., ladder-ways, man-engines, cages, and skips. The dressing of ores, including stamping, washing, and calcining, were next treated, special reference being made to the Californian stamp, which was gradually displacing those of the old Cornish type, the main features of both, however, being identical.

The important advantages obtained by the use of Frue Vanner concentrating machines, as compared with the old processes of buddling and racking, were pointed out. Calcining was effected in a Brunton's calciner, in the form of a reverberatory furnace, the bed being a circular cast iron table 10ft. diameter, and revolving three or four times per hour. The process of calcination eliminated arsenic and sulphur, the former condensing in flues which were cleaned out every three or four months, the white arsenic formed being saleable. Ores containing wolfram received special treatment, being roasted in a furnace with sulphate of soda, forming sodium tungstate, which was then dissolved in water, leaving tin as a residue.

The author then proceeded to describe the reverberatory furnace in which the ore is melted, after being mixed with anthracite and a little lime. The first operation took about seven hours. The metal was then tapped, but was still in a very impure state, and had then to go through the refining processes of liquation and boiling. A description of the blast furnace used in Saxony followed, and it was stated that the loss by this method was about twice as great as that by the English method.

The Cornish method of assaying tin ores was then touched upon, and the various properties of the metal were dealt with, including tenacity, ductility, and conductivity, with reference to heat and electricity. Its industrial applications were considered. The process of tin-plating was described, and reference made to tests applied to tin-plate to ascertain their quality. The various alloys of tin and copper were fully dealt with—bronze, gun-metal, bell-metal, speculum-metal, &c. Phosphor bronze and its uses in engineering were entered into, and the paper concluded with questions relating to the application of tin to the manufacture of fusible alloys.

A discussion followed the reading of the paper, and a vote of thanks having been accorded the author, the proceedings closed with the announcement of the ensuing meeting on January 25th, when a paper on "Railway Construction" would be presented by Mr. Alexander Ross, M. Inst. C.E., Hon. Mem. Inst. J.E., engineer of the Great Northern Railway.

SOCIETY OF ENGINEERS.

THE forty-seventh annual general meeting of the Society of Engineers was held on December 10th, at the rooms of the Society, 17, Victoria-street, Westminster. The chair was occupied by Mr. Charles Mason, vice-president. The following gentlemen were duly elected by ballot, as the Council and officers for 1901, viz.:—As president, Mr. Charles Mason; as vice-presidents, Messrs. Percy Griffith, James Patten Barber, and David Butler Butler; as ordinary members of Council, Messrs. Joseph Bernays, G. A. Pryce Cuxson, W. H. Holttum, R. St. George Moore, Henry Sherley-Price, Nicholas J. West, Joseph W. Wilson, and Maurice Wilson; as hon. secretary and treasurer, Mr. George Burt; as hon. auditor, Mr. Samuel Wood, F.C.A.

During the scrutiny the Chairman addressed the meeting, bringing before the members the salient points of the work of the past year. He announced that the hon. treasurer, Mr. George Burt, had presented to the Society a president's badge of office in gold and enamel. The announcement was received with acclamation, and on the motion of the Chairman it was resolved that the best thanks of the Society be presented to Mr. Burt for his generous and handsome presentation, which is most highly esteemed and appreciated.

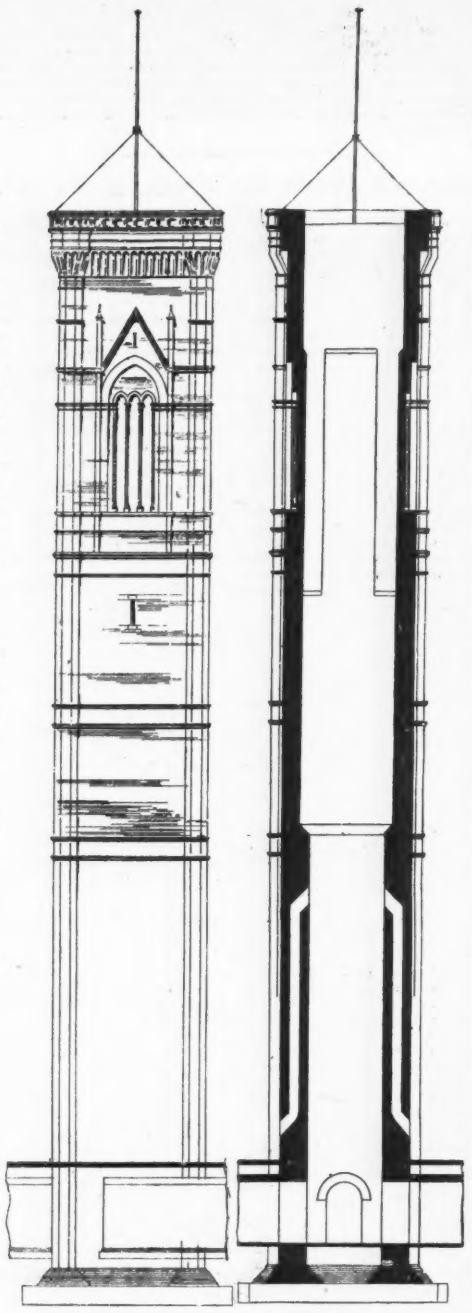
The Chairman also announced that the following premiums had been awarded by the Council for papers read during the past

session, viz:—The President's Gold Medal to Mr. Henry C. H. Shenton for his paper on "Recent Practice in Sewage Disposal;" the Bessemer Premium to Mr. Richard F. Grantham for his paper on "The Closing of Breaches in Sea and River Embankments;" a Society's Premium to Mr. C. Rous-Marten for his paper on "English and French Compound Locomotives;" and a Society's Premium to Mr. Robert Henderson for his paper on "Paper-Making Machinery."

A vote of thanks was accorded to the scrutineers, and the proceedings terminated by a vote of thanks to the president, Council and officers for 1900, which was duly acknowledged.

NEW COMBINED CHIMNEY AND VENTILATING SHAFT FOR THE TOWER WORKS, LEEDS.

At the Tower Works of Harding, Richardson, Rhodes, and Co., Limited, Leeds, engaged in the manufacture of the pins, cards, and combs used in connection with textile machinery, the premises have been enlarged so as to permit the removal of the branch from Horsforth and the concentration of the manufacture at Leeds. The extended works will employ about 500 hands, and advantage has been taken of the reconstruction to equip the factory with every modern improvement. Special attention has been given to the lighting, heating, and ventilation of the various workshops. Ventilation is of special importance in these works,



Elevation. *Section.*

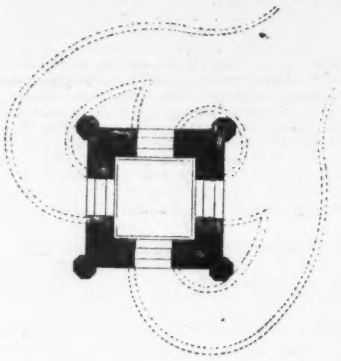
CHIMNEY AND VENTILATING SHAFT

because of the operations of steel grinding, wire pickling, &c., and by the arrangements made these processes will be carried out under conditions of comfort and healthfulness which compare very favourably with the old-fashioned appliances.

A chimney had to be built whose primary purpose was to take the waste products of combustion from a range of Lancashire boilers supplying steam to a pair of compound engines of 700 horse-power made by the well-known firm of Pollit and Wigzell, Limited, of Sowerby Bridge. The chimney has been built of such dimensions as to provide suction power not only for working the boilers, but for ventilating the shops downwards through the machines. The underground flues are constructed with a constantly expanding area until they reach the large circular flue, 10ft. by 10ft., which surrounds the chimney. There are openings on each of the four sides of it as shown in the plan, so that there is nowhere any throttling of the draught. The same principle is carried out in the chimney itself, which has an area of 10ft. square at the bottom inside, and this expands to 12ft. square inside at the top. Sixteen annealing furnaces for steel have been built round the ample base of the chimney, which is 18ft. square outside. The flues from these furnaces pass up for 30ft. within the side walls of the chimney, and are then turned into the main shaft. The large draught produced by the heat of these furnaces and of the boilers dispenses entirely with the use of the fans which would otherwise have been necessary. Arrangements have been made by which the steel dust drawn down into the flues is automatically conveyed by travelling rope gear and an elevator into a chamber where a cart is in position to receive it.

Colonel Harding, the chairman of the company, was very anxious that in erecting this large chimney another eyesore should not be added to the many already visible in the city, and the firm, with great enterprise and public spirit, took for their model the beautiful Giotto tower at Florence. In building chimneys the custom has almost invariably been to reduce the thickness of the walls externally, and thus to give them a tapered form. The Italian towers, or campaniles, are almost always vertical, and their beauty is largely dependent on this feature. In the Tower Works chimney the reduction of thickness of the walls as they rise is made internally, so that, as a result, a vertical tower is obtained with an expanding internal shaft.

The work was intrusted to Mr. W. Bakewell, F.R.I.B.A., the architect of the new works, who has admirably carried



Plan.

CHIMNEY AND VENTILATING SHAFT

out his instructions, retaining as closely as possible the general lines and proportions which make the great work of Giotto one of the architectural monuments of Italy. There has been no attempt, of course, to repeat the gorgeous detail of the original work, or the costly materials which were used at Florence. The Leeds tower is built of pressed red brick, with terra-cotta decorations, and the great window panels are filled with Venetian gilded glass mosaic, which should be as enduring as the brickwork, though possibly the smoky atmosphere of Leeds may to some extent tarnish its glory. The tower rests upon a solid foundation of gravel, the whole area of the base being covered with concrete 2ft. 6in. thick. The illustrations on this page are from drawings furnished by Mr. Bakewell, the architect.

Colonel Harding has set a notable example in this structure, but in doing so is only following a course of action for which he is already well known. He was recently Lord Mayor of Leeds, and has contributed largely to the Art Gallery of the city, as well as to the embellishment of the City-square, where he is about to erect a heroic equestrian bronze statue of Edward the Black Prince.

THE BRACED GIRDER IN BUILDING CONSTRUCTION.

Using the term in a generic sense, it may be said that the braced or "lattice" girder is largely exemplified in building construction, although in this country it is rarely if ever applied for the transmission of heavy loads in warehouse, office, and kindred buildings. In American practice girders of this class are more frequently found, and the example presented by the American Exchange National Bank building, erected a few months ago in New York, is interesting in more than one direction.

Having a frontage of 40ft. on Broadway and 100ft. on Cedar-street, this structure has sixteen storeys, and is about 240ft. high above the street level. As the back wall faces a narrow thoroughfare, only one side of the building is contiguous to the neighbouring premises. In the preliminary excavation, an area of 50ft. by 110ft. was opened up, and the pit extended to a depth of about 23ft., where it finished in a sandy bed interspersed here and there with gravel and earth. This formation was found to extend to a considerable depth, and as the total dead and live weight was estimated at about 10,000 tons, steel grillage foundations were decided upon, designed to transmit to the earth a uniform pressure of 8000 lb., or about 3·57 tons, per square foot. After the bottom of the excavation had been carefully levelled, a bed of concrete, 2ft. thick, was formed over its entire surface, and upon this bed eight groups of steel I beams were laid, their combined area being about half that of the basement floor. Each group is embedded in concrete, which fills all the intervening spaces, and is levelled up to the surface of the upper flanges of the beams. In the case of the four corner groups, it will be seen on reference to the figure that distributing beams are placed in a second tier on top of the grillage foundations. Upon these the columns are set, being built with extended bases, which practically constitute transverse plate girders. The other four grillages extend from side to side of the site, and upon each one is set a deep trussed girder, which transmits the column loads, and distributes them uniformly over the grillage foundation. These girders are all of the same type, but their length varies from 42ft. to 45ft. The girders weigh about 34 tons each, and all of them were assembled and finished in the erecting shop, being afterwards conveyed to the site on wagons during the night time. The columns are riveted to the trussed girders through the gusset connection plates at the panel joints, and each vertical girder post is placed so that it comes immediately beneath a column. As this building is an example of steel cage construction, the seven rows of columns necessarily carry the whole weight of the building and its contents. The main floor beams run in a transverse direction, and are in pairs, one beam being on either side of every column; whilst the joists run longitudinally, and are secured either to the columns or to the webs of the floor beams as occasion may require. At every floor level the columns are stiffened by knee braces, and the column connections consist of side cover-plates and a horizontal diaphragm riveted to both portions of the column by angle connections. The ends of the floor beams project sufficiently beyond the outer faces of the wall columns to form cantilever supports for the channels carrying the several storeys of the brick walls. It may be mentioned that the building contains nearly 1800 tons of steel.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

Heavy goods locomotive.—For handling the heavy coal traffic to Chicago the Chicago and Eastern Illinois Railroad has put in service some twelve-wheel two-cylinder compound engines, built by the Pittsburgh Locomotive Works, and having the Pittsburgh system of compounding. These engines have eight coupled driving wheels, a four-wheel leading bogie truck, and a long, wide fire-box, with the cab placed at the junction of the fire-box and the boiler barrel. The fire-box has a grate area of 72 square feet, and is designed for burning bituminous coal. Its grate has six longitudinal sections, which can be rocked independently. A hood at the back of the fire-box serves to shelter the fireman, who is further protected by a hood over the front end of the tender. Gangways extend from the fireman's cab to the main cab. The general dimensions of the engines are as follows:—

Cylinder, high-pressure	21½in. × 30in.
,, low-pressure	33in. × 30in.
Driving wheels	4ft. 6in.
Bogie wheels	2ft. 4in.
Driving wheel base	15ft. 6in.
Bogie wheel base	7ft.
Total wheel base	26ft. 4in.
Boiler diameter	6ft.
,, pressure	200 lb.
Fire-box, length	9ft.
,, width	8ft.
,, back depth	5ft.
,, front depth	6ft.
Tubes, 300; diameter	2in.
,, length	14ft. 6in.
Heating surface, tubes	2266 sq. ft.
,, ,, fire-box	181 sq. ft.
,, ,, total	2447 sq. ft.
Grate area	72 sq. ft.
Rail to centre of boiler	9ft. 3in.
,, to top of funnel	15ft.
Slide valves, balanced; outside lap	1in.
,, ,, greatest travel	h.p., 5in.; l.p., 6in.
Steam ports	h.p., 18in. × 1¾in.; l.p., 21in. × 2in.
Exhaust ports	h.p., 18in. × 3in.; l.p., 21in. × 3¼in.
Bridges, width	1¾in.
Weight on driving wheels	150,000 lb.
,, on bogie	39,700 lb.
,, total	189,700 lb.
Length, over all	37ft. 6in.
Tender.	
Wheels, eight	2ft. 9in.
Weight, loaded	98,000 lb.
Coal	10 tons
Water	4500 gallons

Centrifugal railways.—Two "centrifugal" railways, in which the carriage describes a circle in a vertical plane, have been in operation within the past summer, and are similar to one built at Liverpool about 1859. One of these, at Boston, has a tower 40ft. high, up which the carriage is hauled by a cable incline. The carriage is then shot down an incline of 30 deg., and on reaching the bottom traverses the vertical loop or circle, which has a diameter of 29ft. After leaving the circle the carriage runs along a circuitous line for a distance of a quarter of a mile. The velocity of the carriage when passing the top of the circle is about seventeen miles per hour. Guide wheels running inside the circle would prevent the carriage from falling in case of accident. The circle is of steel construction, consisting of two circular Warren girders, 2ft. deep and 4ft. apart, connected by transverse members and diagonal bracing. The girders are spiralled laterally, so that the curves lap at the bottom, the entrance and exit being side by side. The loop is not a true circle. The upper part is of 29ft. radius, while the lower parts increase to 35ft. and 40ft. radius. Many people are naturally afraid to risk the trip, but that the adventure is popular is shown by the fact that from 4000 to 11,800 people have made it daily during the summer, the fare being 2½d. The other centrifugal railway is at Coney Island, near New York, and its popularity was fully equal to that of the one at Boston.

The American Exhibition of 1901.—Work is progressing apace upon the buildings and grounds of the Pan-American Exhibition to be held at Buffalo in 1901. This will include the United States, Canada, Mexico, the central and South American States, Cuba, and the West Indies, and the Philippine Islands. The United States Government has granted an appropriation of £100,000, and all the Government departments will have extensive exhibits. The principal buildings are arranged around a court in the form of a T, the main section of which is 500ft. by 200ft., while the transverse section is 1700ft. long. In the main court will be a sheet of water 225ft. by 565ft., and the "electric tower," 375ft. high. Most of the buildings are designed in the Spanish Renaissance style, following largely the features of Latin-American architecture. The United States Government building will be 418ft. by 130ft., with two annexes 150ft. by 150ft.; electrical building, 500ft. by 150ft.; horticultural building, 220ft. by 236ft.; forestry and mining building, 150ft. square; machinery and transportation, 500ft. by 350ft.; manufactures and liberal arts building, 500ft. by 350ft.; agricultural building, 250ft. by 300ft. There will also be several smaller buildings, as well as special buildings erected by individual States. The art gallery will be a permanent white marble structure, costing over £70,000, the building having been devoted by a citizen of Buffalo. All the railways and tramways will centre at a large station, the front of which will be a colonnade 500ft. long, with arches 54ft. high and 36ft. wide. The grand canal will be 50ft. wide and over a mile in length, extending around the central group of large buildings. This will be spanned by several ornamental bridges, and will have branches extending through the grounds. Electricity will be one of the great features of the Exhibition, current being furnished by transmission lines from the great Niagara power plant. The city of Buffalo has a population of 400,000, and an area of 42 square miles. It is a great lake port, the centering point of twenty-six railways, and has 3500 factories and forty-two grain warehouses, with a capacity of 21 million bushels.

Pig iron casting machine.—The new Hartman machine, now in operation in Pennsylvania, has a circular rotating table driven by a pinion and a circular rack. Suspended from the run are steel moulds attached to rocking shafts, forming chords to the circle, each shaft having a gear wheel, which at a certain part of the revolution engages with a rack. This revolves the shaft 180 deg., so that the mould discharges the pig on the outside. The travel of the shaft is limited by stops. Just before reaching the spout, the mould is coated with pulverised bituminous coal dust from a spray device, and then tilts slightly to the rear to allow surplus metal to flow off, but as it passes from the spout it is returned to its normal level. The mould passes through a water spray and then enters a trough, in which the water comes to within 1in. of the top of the mould. Continuing its travel, the surface of the pig is sprayed, and then the mould is submerged. After passing out of the water trough, the rack tilts the mould, discharging the pig into an endless conveyor, which carries it submerged in water for five minutes, and then carries it up an incline and discharges it into a railway wagon. The mould continues inverted so as to drain, until it approaches the duster again, by which time it is quite dry. The machine is put at the end of the cast-house, and fed by a cast iron runner lined with firebrick, which extends from the furnace to the spout. The spout can be raised to stop the flow when required, damming back the metal in the runner. Only three men are required to operate the machine on each shift, and no locomotives, lorries, &c., are required for handling the pigs.

A 40-knot steam yacht.—A twin-screw steam yacht is now being built in New York which is designed to have a speed of forty miles an hour. It will be 130ft. 4in. long, 130ft. on the water-line, 12½ft. beam, 9½ft. deep amidships; draught, 3½ft., 4½ft. under the screws. The displacement on normal 3½ft. draught will be 68 tons. It will carry 17 tons of coal in the bunkers, or 30 tons on occasion, together with 1500 gallons of water. The crew's quarters are forward, then the officer's quarters, the gallery, boiler-room,

engine-room, and the owners' and visitors' quarters aft. The yacht has a flush deck, with rail, a "gunboat" or vertical stern, and a vertical bow. The frames are of steel below the water-line, and aluminium above, with aluminium bulb angles for the deck beams. The sheathing is of mahogany. The screws are driven by two quadruple-expansion engines, with cylinders 11in., 17in., 24in., and 32in. diameter, and 15in. stroke. The piston speed will be 1500ft. per minute, and at 540 revolutions and 350 lb. pressure the engines will develop 4000 indicated horse-power. There are two Mosher water-tube boilers, with an aggregate of 120 square feet of grate, and 5540 square feet of heating surface. The two weigh 13 tons empty and 15¼ tons when steaming. The fire-room is between the boilers, with one big funnel overhead. Each boiler has two horizontal upper drums 20in. diameter, 4ft. apart; below these are two 12in. drums 8ft. apart, and 7½ft. below the upper ones. The length is 9ft., with 8½ft. of grate. Small tubes connected to the inner side of each upper drum curve inward and downward and then outward and downward to reach the tops of the lower drums, which they enter vertically. The pressure will be 400 lb. to 440 lb. at the boilers, and 350 lb. to 400 lb. at the cylinders. There will be distilling and electric light plant, circulating engines, blowers, &c.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

THERE is nothing very gratifying to report about trade this week.

Demand, whether for finished or raw iron, is practically at a standstill until next year.

Ironmasters are engaged in clearing off old contracts, and the only buying that is going on is of a very hand-to-mouth character. In the absence of business, prices are this week scarcely more than nominal. Common bars are selling at £7 15s. and £8 up to £8 10s., and North Staffordshire bars are quoted £8 to £8 5s. Best merchant bars are £9 10s., and marked bars remain at £10 10s., with £11 2s. 6d. as Earl Dudley's price.

Merchant iron generally is just now very slow of sale, and competition is responsible for steadily drooping prices. Best bars are still in steady demand, though the orders remain small, and are for immediate delivery. The amount of buying which is taking place in unmarked iron is scarcely sufficient to test quotations. Hoop iron is quoted £9 to £9 5s.; gas-tube strip, £8 to £8 10s., and nail rods, £8 10s. to £9.

Orders in the sheet iron trade are very limited, and the galvanisers are buying no more than for some time past. Hence the black sheet mills are irregularly employed. Sheets of 20 w.g. are quoted £8 5s. to £8 10s.; 24 w.g., £8 7s. 6d. to £8 12s. 6d.; and 27 and 28 w.g., £9 to £9 5s. Galvanised corrugated sheets are £12 to £12 10s. Midland manufacturers are at present feeling very keenly Welsh competition. Galvanisers in Wales are, as regards carriage alone, £1 per ton better off in the matter of the execution of export orders than most of the Midland galvanised sheet makers.

Steel is better relatively than iron, but even this is not saying much. Bessemer billets are quoted £5 10s. to £5 15s.; best Siemens ditto, £5 15s. to £6; mild steel bars, £8 5s. to £8 15s; plates, £8 to £8 10s.; and angles, £8 to £8 5s.

The Patent Shaft and Axletree Company, Limited, Wednesbury, while running its Monway Steel Works full time, is finding it necessary to run the other works in which steel is manufactured, viz., the Brunswick Works, somewhat irregularly, with the result that several hundred men there are irregularly engaged. For some time past it has been reported that the company, which manufactures steel principally to supply its own needs in the railway wheel and axle and bridge-building departments, has been purchasing American steel, finding it cheaper; and the irregular running of the Brunswick Works is doubtless the result. Whether in the New Year the directors will feel justified after the necessary stop period for repairs, &c., has expired, to keep the Brunswick Works on full time like their Monway Works, must, of course, depend upon the state of trade in the interval.

The workmen employed at the forge of the Bromford Ironworks, West Bromwich, have been given notice to terminate their engagements, and the forge is to be temporarily closed. This will not, however, affect the mills, which are to continue running as usual, puddled bars or steel billets being obtainable from an outside source. The works are among the oldest in the Black Country, and were carried on for over half a century by John Daws and Sons, and subsequently Mr. Scarf, of West Bromwich, purchased the works for a very moderate sum. A large portion of them was never re-started.

The pig iron trade is without material change on the week, either as regards prices or demand, and market quotations are unaltered.

Under the award of Sir David Dale in the Birmingham brass trade dispute a minimum wage is fixed, but he has dismissed the claim of the men to restrict sub-contracting. When more than fifty-four hours in any week is made, overtime at the rate of time and a-quarter will be paid. With regard to the bonus question, he does not allow the employers to reduce it unless it is uniform all round, and provides that if non-union men are employed they are to receive the full bonus.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—The very insignificant business just now passing through, mostly consisting of the smallest possible quantities which consumers dribble out only when they can no longer hold back from buying, affords no real basis upon which to judge of the actual situation in the iron and steel trades of this district. The real question is what the turn of the year is likely to bring forth; and although a few isolated speculative forward transactions that are reported can scarcely be accepted as really establishing any future basis, they are certainly indications that, in some quarters at least, very much lower prices are anticipated, one or two contracts for pig iron for delivery extending well over next year having been made at several shillings per ton under even the present low quoted rates.

The reports which come to hand from some branches of engineering, and also the further employment returns issued by the trade unions, become less encouraging as to the future. All sections of engineering, either directly or indirectly, connected with electrical work are, of course, participating in the exceptional pressure of electrical development now going on, and locomotive builders and manufacturers of railway rolling plant generally also continue exceedingly busy. Outside this, however, the tendency continues unmistakeably in the direction of lessened activity, and in some directions I hear that new orders are not coming forward at all so satisfactorily as could be wished. The monthly returns of the Amalgamated Society of Engineers show a decidedly less satisfactory position as regards employment. The organising delegate for the Manchester district reports that the number of unemployed has gone up to 4 per cent., as compared with about 2 per cent. last month, and adds that this is largely due to the continued depression in the textile machine trades and the discontinuance of night shifts in some of the general engineering shops. Activity, he states, is fairly well maintained at works engaged in making tools and ordnance, and a considerable amount of overtime is still being worked in such establishments. Generally, he remarks, there is not that call for men which marked the earlier months of the year. The general office report of the society also shows an increase in the number of unemployed members, but not to any large extent, and the out-of-work list still represents not much more than 2½ per cent. of the total membership.

There was only a moderately-attended and extremely slow iron market at Manchester on Tuesday. A continued downward move in pig iron prices only still further checks the already exceedingly restricted weight of buying. Lancashire makers are now quoting nominally 67s. 6d., less 2½, for foundry delivered Manchester, about 2s. 6d. under last week's rates, but are practically not selling at this figure. Lincolnshire makers have further reduced their official basis rates 1s. per ton, bringing them to 59s. 6d. net for No. 3 foundry, with Derbyshire nominally about 63s. 6d. to 64s. 6d. net, delivered Manchester. Forge qualities have also been again reduced, and, delivered Warrington, the average quotations are now about 61s., less 2½, for Lancashire, 59s. 2d. net for Lincolnshire, and 59s. to 59s. 6d. for Derbyshire. In American forge iron further sales are reported at something very near the basis of 60s., delivered Warrington, quoted last week. Middlesbrough iron is lower, and various prices are quoted, but 61s. 10d. net for prompt delivery Manchester may be taken as representing about an average figure. Scotch iron, delivered Manchester docks, ranges from about 70s. 6d. to 71s. 6d. net for Eglinton and Glengarnock, with American foundry still about 63s. net.

Finished ironmakers have taken up a position of waiting developments, and as there will be no further association meetings until after the turn of the year, the list prices will in the meantime remain on the basis of £8 for Lancashire, with North Staffordshire bars quoted £8 to £8 5s. delivered Manchester district. In the open market there is a good deal of competition for any small orders to be got, and where particular makes of bars are not specified, sellers are prepared to book at £7 15s. to £7 17s. 6d. delivered. Sheets remain at about £9 to £9 5s., and hoops £9 2s. 6d. for random to £9 7s. 6d. for special cut lengths, delivered here, and 2s. 6d. less for shipment.

In the steel trade prices for raw material remain without quotable change. For No. 3 foundry hematites 80s., less 2½, is about the minimum makers' price, with local billets nominally £5 10s. net, but there is no business of any moment stirring. In manufactured material prices are so irregular as scarcely to admit of definite quotation. Steel bars and common steel plates are reported to be obtainable at under £7, and certainly there are sellers at £7, with quotations according to quality ranging upwards from this figure. Since the temporary suspension of the Makers' Association prices for boiler plates have been cut very low to secure any orders that are to be got. Nominally, £8 5s. is about the general quotation of the associated makers for delivery in this district.

Business in the metal market continues slow, and there has been a reduction of ¼d. per lb. on seamless brass and copper tubes, and brazed copper, and yellow metal condenser plates, the basis quotations being now 8d. per lb. for seamless brass tubes; 10¾d. for copper tubes, 10¼d. for brazed copper, and 7d. for condenser plates. Brass wire and sheets, which were recently reduced ¼d. per lb., are unchanged.

It is reported that Willans and Robinson, of Rugby, have taken about 35 acres of land at Sandycroft, where they intend to erect new steel and boiler works on a large scale.

The position in the coal trade here continues strong, and in all descriptions of fuel the output is moving away readily at full rates. Taking the market generally, however, the continued competition of both round coal and engine fuel coming in from other districts, Yorkshire, Staffordshire, and Derbyshire, is a feature that is not altogether satisfactory with regard to the future. At present this competition is not appreciably affecting Lancashire collieries, as they have no surplus stock that they are under any necessity to push on the market, but it has the effect of encouraging merchants and large buyers to hold back from purchasing beyond immediate requirements, in view of possible lower prices ruling after the turn of the year.

The Lancashire Coal Sales Association had the question of prices under consideration at a meeting held in Manchester on Tuesday, and it was decided that any advance on current rates was not under present conditions advisable. One important matter that came forward for consideration was the question of contracts for next year, and this had special reference to the large contracts for engine fuel usually made with the Alkali Union, the renewal of which has recently been the subject of a good deal of negotiation. As, however, it had become evident that satisfactory terms could not be arranged with the Alkali Union, a resolution was unanimously adopted by the meeting to the effect that no further concession should be made on the minimum basis that had been submitted, and that if contracts could not be arranged on this basis, the Alkali Union must purchase for their requirements in the open market.

As to the position of engine fuel generally, Lancashire collieries report that they have a ready sale for all they are able to produce. Current pit prices remain exceedingly firm on the basis of about 10s. 6d. for good medium sorts, to 11s. and 11s. 6d. for some of the special qualities. Common round coals for steam and forge purposes are moving off fairly well, and notwithstanding many of the ironworks are on short time, and the general depression throughout this branch of trade, no surplus of any moment is accumulating at pits, and quoted prices remain steady at about 12s. to 12s. 6d. The house-fire coal trade is just now fairly active.

For shipment only a limited sort of business comes forward, with prices about as last quoted, ordinary steam coal delivered Mersey ports being readily obtainable at about 15s. to 15s. 3d. per ton.

Good foundry cokes continue in very fair request, with quoted rates unchanged, and furnace cokes also remain nominally without alteration.

Barrow.—There is very little change to note in the hematite pig iron trade of this district. Orders are not plentiful, but are fairly well held by smelters, some of whom decline to quote at the cheap prices which have been induced by the operations in hematite warrants. The latter are now quoted at 66s. 6d., net cash, at a month, buyers 6d. less. Some makers are quoting mixed Bessemer numbers at 70s. to 65s. per ton net f.o.b. It is not probable that any improvement in the consumptive demand will establish itself for a month or two, but the outlook generally indicates a better trade in the early spring. Stocks of warrant iron have again been reduced this week to the extent of 1225 tons, and they now stand in warrant stores at 22,638 tons, the clearance this year being no less than 175,209 tons. Thirty-seven furnaces are in blast, compared with 47 in the corresponding week for last year.

Iron ore commands a good sale on the market and is firm, good ordinary sorts being at 17s. net at mines. Rubio ore, which is still largely used in the district, is selling at 18s. per ton net at West-Coast ports.

The steel trade is inanimate. Orders are scarce, although prices have been reduced. The heavy rail trade is weaker, and new orders are not expected until the beginning of the year, but prospects are said to be good in this department. Not so in the steel shipbuilding material department. The plate mills in Barrow have been busy during this month on orders for January delivery, and new business is coming slowly in. There is a brisk demand for hoops, billets, and merchant steel. Prices generally in the steel trade are weaker.

There is nothing new to report in the shipbuilding and marine engineering trades, which, however, are busy.

Coal and coke have gone down in price; the consumption is below the average, and deliveries are full.

Work has again been resumed in the lowering of the Ramsden Dock sill by 6ft. The engineers in charge of the work have decided on the sinking to the required depth in sections, piling as they go along, so as to make a safe job of it.

The shipping trade is quiet. The exports of iron last week represent 7733 tons and steel 7040 tons, as compared with 10,582 tons of iron and 14,738 tons of steel in the corresponding week of last year, a decline in iron of 2849 tons and in steel a decrease of 7698 tons. This year the shipments of iron have reached 606,577 tons and steel 396,945 tons, as against 523,869 tons of iron and 480,517 tons of steel in the corresponding period of last year, an increase in iron of 82,706 tons and in steel a decrease of 83,572 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

UNCERTAINTY still characterises the Yorkshire coal trade, more especially in locomotive fuel for railway companies. As has been anticipated, the Yorkshire coalowners have given way with a view of effecting a speedy and amicable settlement of the contracts commencing the first day of January next. It will be remembered that the coalowners reduced their price from 16s. to 15s. per ton, but the railway managers looked upon this as not adequate. A meeting was held in Sheffield on the 17th inst., at which the coalowners had before them the reply of the Midland Railway Company, stating that it could not give 15s. a ton. It is understood that this company has already been buying supplies of Notts and Derbyshire coal at 13s. 6d. per ton. Notts and Derbyshire coal does not fetch a price equal to Yorkshire hards, but the coalowners, having regard to all the circumstances, have decided to offer the Midland and other companies supplies at 14s. a ton. This will make an enormous difference to the railway companies, and it is highly probable that the offer may be accepted. To the Midland Company alone a reduction of 2s. a ton means a saving in the yearly coal bill of £135,000 on a consumption of 1,350,000 tons. Contracts, it is expected, will be for three months or six months, there being a strong feeling in railway circles that coal may yet come lower, and that for the later months of next year they may be able to arrange on still easier terms. That feeling does not seem to prevail amongst coalowners, who believe that in the spring or shortly afterwards their business may again get firmer.

In regard to house coal, colliery owners are depending upon a change in the weather, of which there is not the slightest prospect at present. It is a long time since we had such a mild December, and this fact, coupled with the premature stocking which took place in the panic days of September and October, causes this trade to be very quiet. Coalowners state, however, that a fair tonnage is being brought to bank, and they stand pretty stiffly to the old quotations: Best Silkstones, 15s. to 16s. per ton; Barnsley House, 14s. to 15s. per ton. These prices are still required from householders, though easier terms can be had for large quantities.

In spite of the closing of the Baltic ports, there is still a fair export demand for steam coal, the requirements of other countries making up for the stoppage of business elsewhere; Barnsley hards are still quoted 15s. to 16s. per ton. Gas coal continues in exceptional demand on contract account. Engine fuel is also more freely asked for, quotations being well maintained:—Nuts, 9s. 6d. to 10s. 6d. per ton; screened slack from 7s. 6d. per ton; pit slack from 6s. per ton. The coke trade is still on the down grade, ordinary coke being procurable at 15s. per ton, and washed coke from 18s. per ton.

The unsatisfactory condition of the iron trade is causing considerable concern. Concessions made by ironmasters, instead of encouraging business, have depressed it, as purchasers hold back in the belief that further concessions are sure to follow. It is not likely that any improvement can take place until well into the new year. Another heavy drop took place in hematites this week, these irons being now easily procurable at 80s. for East Coast, and 82s. for West Coast. For forge iron no price can be stated.

In the steel trade manufacturers of crucible qualities complain all round of slackness. Some of our best firms are now working not more than four days a week, while in other directions the depression is even more pronounced. Makers of open-hearth steel, on the other hand, continue to be well employed; but there is no disposition to accumulate stocks, the high cost of production causing manufacturers to restrict their attention to the filling of orders. Several of the rolling mills are now running short time, the most significant indication that can be given of the unsatisfactory condition of this and allied trades.

Cutlery manufacturers, as well as those engaged in the plating trades, report that the season's business is not equal to expectations Novelties for Christmas and New Year attract attention, but generally the demand is lighter than usual, and advances in material reduce profits very considerably.

NORTH OF ENGLAND.

(From our own Correspondent.)

A SOMEWHAT more satisfactory report can be given this week anent the iron market than has been possible for some time past. Business is still exceedingly quiet, but the tone is not so despondent as of late, and the downward course of prices has at last been checked. It is some time since they were so steady as they have been since Tuesday. The experience of sellers has during the last three months been absolutely unique and unprecedented. In all other periods of declining prices the course has been of a switchback character, there being every now and then slight rises in the quotations, but since the middle of September last there has been one unbroken fall, not a penny rise being reported during the three months, and the fall has been extremely rapid this month. No. 3 Cleveland pig iron since September has declined in value at least 18s., of which 10s. 6d. has been reported within the last three weeks.

But pig iron prices have become steadier this week, the makers and merchants having at last set their faces against the continuous beating down of values. Pig iron has got down to figures which cannot cover the cost of production, and in some cases, indeed, the selling prices are shillings below cost. Merchants also cannot realise any profits by selling at the prices that are now offered. It is not owing to any action on their part that the value of iron has declined with such a run. As a matter of fact they have little iron available for sale, and that little was bought at rates considerably above those now ruling, so they are as much disposed to stand out against further reductions as the makers themselves. It is at least a year and a-half since they were able to buy iron at anything like the prices at present being offered. The rapidity with which the value of iron has been falling of late, and the heavy increase in stock, have impressed upon the makers the necessity for taking some steps to counteract the unsatisfactory situation, and they have acted accordingly.

Steps are being taken to reduce the output of pig iron to the level of the requirements, and several furnaces in addition to those already reported in this column are to be blown out or damped down; indeed, by the end of this week there will be six fewer furnaces at work in the North of England than was the case at the beginning of the quarter—leaving 91 at work—and this will bring down the output by 600 or 700 tons per day. Sir B. Samuelson and Co., Limited, Newport Ironworks, Middlesbrough, have blown out a furnace this week, making two this quarter, and in addition they will damp down two furnaces and probably keep them so for some time. Other makers are contemplating the blowing out of one or more of their furnaces, as they do not see the necessity for making pig iron at a loss to be put into stock. By stopping furnaces they will probably not only stop the downward movement in the prices of pig iron, but will reduce the cost of production, as the consumption of coke will be lessened, and lower rates accordingly will rule. There is no doubt that for a long time coke has been relatively a good deal dearer than pig iron.

The stock of Cleveland pig iron in Connal's warrant stores, which was down to 10,463 tons on September 4th—the smallest quantity that has ever been reported since Messrs. Connal took over the stores in 1877—has increased so much that on Wednesday night the quantity was 33,564 tons, 9325 tons having been added this month alone, and the quantity is heavier than it has been since last April. After all the stock even now is small, but it is the rapidity with which it is now increasing that is rather disquieting. Only within the last five years the quantity held was over 310,000 tons, or nearly ten times more than at present. Makers appear to be averse to produce iron to be sent into the public stores, or to accumulate at their own works.

The December shipments of pig iron are on a smaller scale than has been known in any month for nearly six years; they are little more than half the average of the previous months this year, being exceedingly poor to overseas ports, and the deliveries to Scotland have not improved to any considerable extent, though Cleveland prices are a good deal below Scotch. Up to Wednesday night 31,263 tons were shipped from the Cleveland district, as compared with 49,954 tons last month, and 58,735 tons in December, 1899. When this decline in exports is taken into account, and at the same time the reduction in local consumption, the heavy increase in stocks is only what might be expected, but it will be at a smaller rate than it has been, now that so many furnaces have for the present ceased to produce iron, and that more furnaces will be stopped.

The amount of business doing in Cleveland pig iron this week, though very small, has yet been larger than for some weeks past; but consumers still confine their purchases to small lots for immediate delivery, and cannot be induced to buy for forward delivery. They prefer to wait the development of events. Business in No. 3 Cleveland pig iron has been done generally at 53s. 6d. per ton, this being 2½s. 6d. per ton below the best price of the year, and lower than anything reported since May, 1899. It is 4s. below the rate ruling on Tuesday last week. The lower qualities of Cleveland pig iron are not so much below No. 3 as they have been nearly all the year. Usually grey forge is 1s. per ton cheaper than No. 3, but in the early part of September was 5s. 9d. cheaper, whereas now the difference is only 1s. 6d., for it is realising 52s. No. 4 foundry is at 53s. Hematite pig iron has not dropped so much in value as Cleveland pig iron—only 17s. 6d.—and instead of the difference between the two being 10s., it is 16s. 6d., for mixed numbers of hematite are now being sold at 70s., and No. 1 has been sold by one of the leading makers at 71s. There are, however, producers who still ask 72s., but consumers do not see their way to give it.

Finished iron and steel are in very quiet request, and the holidays this month will be longer than usual—a full week, this being longer than the majority of manufacturers have been able to afford for several years past. But business is by no means pressing, and firms, though only running their mills short time in some cases, are yet ahead of their contracts. The rail makers have found it necessary to reduce their quotations; it is difficult to find out what they really would take, but for heavy steel rails they quote £5 17s. 6d. net at works, or 37s. 6d. less than the top price of the year. At the same time, founders have reduced the quotation for cast iron railway chairs to £4 7s. 6d. net. Other prices have been maintained, common iron bars at £8; best bars, £8 10s.; iron ship plates, £6 12s. 6d.; steel ship plates, £6 15s.; iron and steel ship angles, £6 15s.; engineering angles, £7; steel boiler plates, £9 5s.; and steel hoops, £9; all less 2½ per cent. f.o.t.

The coal trade is not so strong as it was, and business has been much interfered with on the Tyne, Wear, and at Hartlepool, owing to the strike of mineral guards at Tyne Dock, and of other of the North-Eastern Railway Company's servants who sympathised with them. Both coal and goods traffic has been considerably lessened, shipments have been reduced, and collieries in many cases have had to be stopped for several days during the last fortnight. The grievance of the mineral guards appears to be practically a sentimental one. Each guard has been accustomed to have his particular van, and when it was ordered that in future a guard should take the first van that was available, the men struck work without giving notice. The company says the arrangement of having "one man one van" is the cause of much inconvenience and delay to traffic. Mr. Bell, M.P., the secretary of the Railway Servants' Association, intimated to the men that they could not expect any financial support from the society, as they had broken the rule, striking without notice, and after various negotiations he prevailed upon them to resume work on Tuesday; and the dispute will be considered by the general manager next week, when he will receive Mr. Bell and a deputation of the men. In the meantime the "one man one van" arrangement will be continued where it does not delay the traffic. Since the conclusion of the strike prices of coal have been rather easier. Best steam coals are at 14s. to 15s. f.o.b. Coke of medium quality has been sold at 17s. 6d. per ton, delivered at Middlesbrough, and two or three contracts for execution over next quarter have been placed at a little below that.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

AFTER a drop of 8s. per ton in warrants, which took place in the course of two weeks, it is not surprising that there should be an improvement of some 2s. per ton, such as occurred in the last few days. There is a strong impression, however, that prices of pig iron are still bound to go lower. The nearness of the holidays tends to prevent either shippers or home consumers buying iron at present.

Business has been done in Scotch warrants from 60s. 3d. to 61s. cash, and 59s. 10d. one month. Transactions have also taken place from 60s. 10d. to 59s. 10d. for delivery in thirteen days. Cumberland hematite warrants have sold at 66s. 6½d. cash, and at 66s. 6d. to 66s. 3d. for delivery in ten days. Cleveland warrants have been done at 52s. 9d. cash, and the same price for ten days' delivery.

There has been a further reduction in Scotch hematite, which is now quoted by merchants 77s. 6d. per ton for delivery at the steel works. This is a fall of 6s. 6d. per ton since the downward course of prices began.

The furnaces in blast in Scotland number eighty-two, compared with eighty-three at this time last year, and of the total, forty-one are producing hematite, thirty-six ordinary, and five basic iron.

A further general decline has occurred in the prices of the special brands of Scotch makers' pig iron.—Govan, No. 1, is quoted f.o.b. at Glasgow 61s. 6d.; No. 3, 61s.; Wishaw, No. 1, 62s.; No. 3, 61s. 6d.; Carnbroe, No. 1, 71s.: No. 3, 67s. 6d.; Clyde, No. 1, 78s. 6d.; No. 3, 68s. 6d.; Gartsherrie, No. 1, 78s.; No. 3, 68s.; Calder, No. 1, 79s.; No. 3, 68s. 6d.; Summerlee, No. 1, 81s.; No. 3, 68s.; Coltness, No. 1, 85s. 6d.; No. 3, 69s.; Glengarnock at Ardrossan, No. 1, 79s.; No. 3, 61s.; Eglinton at Ardrossan or Troon, No. 1, 67s. 6d.; No. 3, 66s.; Dalmellington at Ayr, No. 1, 68s.; No. 3, 66s. 6d.; Shotts at Leith, No. 1, 82s. 6d.; No. 3, 70s.; Carron at Grangemouth, No. 1, 78s.; No. 3, 68s. per ton.

The shipments of pig iron at Scottish ports in the past week have been 5272 tons, compared with 4111 in the same week of last year. There was despatched to Canada 90 tons, India 242, France 199, Italy 219, Germany 345, Holland 253, Spain and Portugal, 105, China and Japan 315, other countries 619, the coastwise shipments being 2885 tons, against 1955 in the same week of last year. There is at the moment comparatively little demand for export, but the total shipments for the year will be about 55,000 tons larger than in 1899.

The Glasgow pig iron market will be closed from Friday of this week—the 21st December—till the 26th, for the Christmas holidays, and again from the afternoon of Monday, the 31st, till Thursday, 3rd January, for the New Year holidays.

There is no improvement in the condition of the malleable iron trade; indeed, the demand is so backward that in a number of cases it is very difficult to keep works moving.

The steel works are fairly well employed, and a few orders have recently been placed, from which they are likely to benefit; but the outlook is not at all so cheering as could be desired. As is well known, a great proportion of the contracts of the steel makers arises from shipbuilding. Some Government orders are on hand, and one or two of the great steamship lines have been arranging with shipbuilders to lay down new vessels. For general merchantmen, however, there is just now practically no demand, the state of the freight market is not encouraging, and the prices at which tramp steamers could be built are still too high for owners to come into the market.

The coal trade is becoming gradually slacker. Shipments from the Scottish ports are, on the whole, good for the season, but the trade is irregular and the current demand unsatisfactory. Household coals for home use have been in good demand, and there has not been much reduction in these, only about 1s. per ton, delivered in the larger towns. The fall has been greater in some of the country districts. Prices of shipping coals are, however, very materially reduced. At Glasgow harbour they are quoted from 10s. 6d. to 14s., according to quality and relative demand. The impression is that it will be very difficult to maintain prices at the present figures for long.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE Belgian ironmasters who have taken the Morfa Colliery, near Llanelly, as stated by me last week, have also, I hear, through their representative, secured other mineral tracts in the district.

The Alexandrian State Railway contract for 90,000 tons best Monmouthshire has been secured by Pyman, Watson, and Co.; price, 25s. 2d. c.i.f., delivery over January to June. Messrs. Cory are stated to have obtained the Brazilian Railway contract of 140,000 delivery over 1901. Last week there was a good despatch all round, Newport despatching over 73,000 tons, and Swansea 61,000 tons, or 20,000 tons over the corresponding week. Cardiff's export was large, and this week was well begun with a despatch of thirty-three steamers, with a total close upon 74,000 tons. France, Spain, and Genoa figured for good totals, and exceptionally large ones went to Colombo, Port Kilindini, and Buenos Ayres. Newport, Mon., despatched eight steamers on the same day, several large ones were laden by Powell Duffryn, Pyman, Watson, and Co., &c.

Steam coals, which have been quoted from 17s., have touched 21s. during the last few days, and remain firm. House coals yet lag somewhat on account of the exceptional weather. The chief coal in demand are steam, large and small; seconds are firmer, and No. 2 and No. 3 Rhondda.

Closing prices, Cardiff, were as follows:—Best steam coal, 20s. to 21s.; seconds, 17s. 6d. to 19s.; drys, 17s. to 17s. 6d.; best steam small, 10s. 6d. to 11s. 6d.; seconds, 9s. 6d. to 10s.; drys and other inferior sorts from 8s. 6d.; best Monmouthshire large, 17s. 6d. to 18s. 6d.; seconds, 16s. 3d. to 16s. 6d.; best house coal, 20s. to 21s.; seconds, 17s. to 18s.; No. 3 Rhondda, 17s. 6d. to 18s. 6d.; brush, 15s. 6d. to 16s.; small, 12s. 6d. to 13s. 6d.; No. 2 Rhondda, 15s. 9d. to 16s. 3d.; through and through, 13s. to 14s.; small, 8s. to 8s. 6d.

Patent fuel, 19s. to 22s.; coke, 24s. 6d. to 36s., according to brand. Patent fuel continues in good demand. Last week Cardiff despatched a good average, and Swansea over 11,000 tons, France and Algeria being the leading buyers.

Latest coal business done: Cardiff steam was on the basis of 20s. to 20s. 6d., and tendency firm; stems reported full, and all collieries and docks busy with old contracts. Much new business is not expected until after holidays. Keen attention is paid to the railway war, and the persistent efforts to reduce prices.

The latest Swansea prices are as follows:—Anthracite, finest hand-picked, 23s. 6d. to 24s.; seconds, 20s. to 21s.; best large, 15s. 6d. to 17s.; red vein, 13s. to 13s. 6d.; rubbly culm. 8s. to 8s. 3d. Steam coal, 16s. to 20s.; bunkers, 13s. to 14s.; small, 7s. to 9s. House coal, No. 2 Rhondda, 15s. 6d. to 16s. 6d.; small, 13s. to 13s. 6d. Patent fuel, 18s. to 18s. 6d. Coke, furnace, 21s. to 24s.; best foundry, 31s. to 33s. 6d.

I regret to announce the death of Mr. J. Walter Morgan, J.P., Hirwain. By profession an engineer, he was associated in early years with Welsh industries, notably at Whitchurch, near Cardiff. He then went to South America, and later was connected with Hirwain works and crucible steel make. Few men were more popular.

The shipment of tin-plates from Swansea was heavy last week, and stocks are lower.

A curious item occurred in the list of Cardiff imports this week, which is calculated to lead to some discussion. It is not of coal to Cardiff, but fish-plates and rails from Rotterdam consigned to the Cardiff tramways.

Slackness prevails in some branches of the Bessemer works, though to the casual glance a good deal of activity continues. The Cyfarthfa Works keep up with remarkable vigour, and Dowlais is yet busy in some departments. Cardiff despatched this week from the works on the hills a cargo of 624 tons iron and 913 tons coke to Port Adelaide, Newport a cargo of steel angles for Belfast. The imports to Newport, Mon., included 1020 steel billets from Philadelphia. Cyfarthfa Works received a large quantity of ore from Bilbao during the week, and Tredegar Works 2320 tons from Garucha.

In connection with American bars, it was stated on 'Change, Swansea, this week that a considerable quantity has yet to arrive in respect of contracts undertaken before Welsh ironmasters had resolutely entered upon the task of meeting the competition.

Prices quoted this week are regarded by thoroughly disinterested authorities as quite low enough to meet the case, and if this can be continued, and there is no doubt of this if workmen take a common-sense view, and the quality is maintained—and upon this there is no question—then the brunt of the rivalry will have passed. It was openly stated on 'Change that there are grave objections raised in reference to the continuance of the use of these imported American bars, the consumers having met with serious difficulties in the re-conversion of the shearings into bars, the steel bars thus produced being of much inferior quality. I have previously referred to other rivals of Welsh ironmasters coming forward in the form of German agents offering at a low rate. In connection with this, it was stated on 'Change that little or no importance was attached to it. The make is presumed to be Bessemer basic steel. Those who have tried this class of steel before say it is, as a rule, faulty and unreliable, and considerable improvement must have been made in the manufacture to fit it for the purposes required by Welsh tin-plate manufacturers. Doubtless the new manufacture will come into use experimentally by a small "parcel" or so, and interest will be awakened to learn with what results. Workmen, I am told, look with disapproval upon these experiments. The older hands can tell the steel required by the touch, and without being aware of the source, select Welsh make—notably Cyfarthfa and Dowlais—as containing the exact percentage of carbon required. I dare say Ebbw Vale and Blaenavon would run these hard, but this is the statement given by practical and disinterested men.

A general reduction of wages is imminent. Prices of raw materials are running down. Block tin has dropped £9 during the week. Iron and steel quotations this week at Swansea were as follows:—Glasgow warrants pig iron, 60s. 7d. to 60s. 9d. cash; hematite warrants, 66s. 6d. f.o.b.; Welsh bars, £8 to £8 2s. 6d.; sheet iron, £8 5s. to £8 7s. 6d.; steel sheets, £8 2s. 6d. to £8 5s.; steel rails, heavy section, £6 to £6 2s. 6d.; light, £7 to £7 15s. Bessemer steel: tin-plate bars, £5 5s.; Siemens best, £5 7s. 6d.

Tin-plates: Bessemer steel cokes, 13s. 3d. to 13s. 6d.; Siemens, coke finish, 13s. 6d. to 13s. 9d.; ternes per double box, 20 by 20 C, 24s., 26s., to 29s. 6d.; best charcoal, 14s. 6d. to 15s. 6d.; big sheets for galvanising, 6ft. by 3ft. by 30 g., per ton, £10 10s. to £10 12s. 6d. Block tin, £113; spelter, £18 12s. 6d.; lead, £16 7s. 6d.; copper Chili bars, £71 10s. to £72. Iron ore dull, declining; Tafna, 17s. 6d.; Rubio, 18s.; Cardiff and Newport prices are from 17s. 3d. to 17s. 6d. c.i.f.

At Briton Ferry last week five smelting furnaces were in full work. Make of steel bar satisfactory. Men are now working day-by-day contracts, the notice issued by directorate having expired. All the mills and departments at the various tin-plate works well occupied, brisk business being done at the engineering works of Taylor and Sons, also at the Swansea Valley engineering works. Foundries generally fully employed. Spelter works active.

The Cardiff Railway Company's Bill has been deposited. One of the special features is what is in local circles described as an extraordinary demand on the Rhymney Railway. Clause 7 provides that the company shall carry into effect arrangements specified for marshalling and sorting the traffic, and also, by Sec. 2, working the traffic between the collieries and the works.

An important meeting of the Executive Committee of the Sheet and Tin-plate Makers' Association was held at Swansea on Tuesday, Mr. Trubshaw presiding. In the matter of circle annealing—a differentiation of prices between circles and squares—a resolution was arrived at which will be submitted to the men. In connection with "tinning at the Barry pot," it was agreed that 2½d. should be paid. If not accepted, then arbitration. It appears that there are fifty-five fewer mills at work in the trade than there were twelve months ago.

NOTES FROM GERMANY.

(From our own Correspondent.)

THE general condition of the iron market over here has not altered, and certainly not improved, since last week. The number of orders given out is very small, and competition keener than ever. There is nothing of interest to relate with regard to the business done in the different departments, pig iron being in moderate request, and comparatively firm in price, while the various sorts of manufactured iron remain in dull and irregular demand, and the downward tendency in prices has been increasing. Girders are particularly quiet, and the trade in bars and plates leaves much to be desired, both as regards inquiry and quotations. At a recent tendering for railway material, the prices asked were considerably lower than the list rates, bars in malleable iron being offered at M. 135 to M. 188, while bars in basic only realised M. 114 p.t. The lowest offer in hoops was M. 143 p.t. Iron plates have in one special case been offered at M. 140·50 p.t. by a Lorraine iron, but the price generally quoted is M. 180 p.t. Sheets were offered at M. 135 p.t.

German export in machines is reported to have been, during the first nine months of present year, 1,788,494 q., worth M. 188,324,000; against 1,664,164 q., worth M. 135,296,600, for the same period last year. Export accordingly shows an increase of 124,330 q., value increasing, M. 3,028,000. Export in German machines to the different countries was as under:—Russia, 363,800 q., or 20·3 per cent.; France, 200,452 q., or 11·2 per cent.; Austria-Hungary, 191,793 q., or 10·7 per cent.; Italy, 130,069 q., or 7·2 per cent.; Belgium, 105,714 q., or 5·9 per cent.; Switzerland, 86,586 q., or 4·8 per cent.; Low Countries, 78,152 q., or 4·3 per cent.; Spain, 67,596 q., or 3·7 per cent.; Sweden, 38,637 q., or 2·2 per cent.; United States, 25,159 q., or 1·4 per cent.; Denmark, 20,149 q., or 1·1 per cent. Export in German machines during the first nine months of present year was 987,605 q. higher than import in foreign machines to Germany, and value of export was M. 74,484,000 higher than value of import.

The Austro-Hungarian iron trade continues to get weaker, consumers only buying what they require for immediate consumption, and that is not much, as all departments are but very moderately engaged. The outlook, generally, must be considered as uncommonly dull.

On the Austro-Hungarian coal market demand and prices have been steadily decreasing upon the week. In brown coal, on the other hand, both home and foreign inquiry has continued very brisk. Coke, too, is in good call, and very firm in price.

The tone of the Belgian iron market is depressed. The construction shops are, on the whole, fairly well supplied with orders, but the rolling mills complain of being hard up for fresh work, and German competition is so keen that, unless the Belgian coalowners reduce their quotations, and thereby enable the ironworks to quote prices as low as the Germans, the weakness in the Belgian iron industry will increase. The fact that 700 wagons for Italian railways have, at a recent tendering, been granted to a German firm, has naturally tended to increase the depression already felt. At another tendering for 6000 t. to 7000 t. rails, the Belgian works have likewise been unsuccessful, the order being granted to Italian shops, although the offers of Belgian works in Denain and Anzin were lowest.

All sorts of coal show a falling off in demand, with the exception of anthracite, for which a very good inquiry is experienced. Reductions in price are willingly granted, especially where forward orders are in question; but these are scarce, consumers, as a rule, preferring to purchase only what they require for the moment. Steam coal is officially quoted 19f. to 20f. p.t., dry sorts fetching 18f. p.t.

The production of pig iron in Russia during the first six months of present year was 87,367,527 pud, against 81,551,399 pud for the corresponding period last year, increase amounting to 5,816,128 pud. Import in iron and steel has, on the other hand, decreased, as may be seen from the following figures:—During the first six months of present year 1,552,000 pud pig iron have been imported, against 3,422,000 pud during the same period last year; import in malleable iron was 2,984,000 pud, against 9,246,000 pud; import in steel 705,000 pud, against 1,254,000 pud.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal market is firm; prices remain about the same as last quoted. There has been a good supply of tonnage come on. House coal remains unaltered. Exports for week ending 15th were: Coal, foreign, 57,527 tons; coastwise, 16,331 tons. Imports for week ending 18th were: Iron ore, 13,350 tons; manganese, 2900 tons; iron scrap, 276 tons; steel scrap, 225 tons; pig iron, 550; steel billets, 1020 tons; pitwood, 3244 loads; deals, 1114 loads.

Coal: Best steam, 17s. 6d.; seconds, 16s. to 16s. 6d.; house coal, best, 19s.; dock screenings, 9s.; colliery, small, 8s. 6d. Pig iron: Scotch warrants, 61s. 6d.; hematite warrants, 66s. f.o.b., Cumberland, prompt; Middlesbrough, No. 3, 52s. 1d. Iron ore: Rubio, 17s. 3d. to 17s. 6d.; Tafna, 17s. to 17s. 3d. Steel: Rails, heavy sections, £6 to £6 2s. 6d.; light ditto, £7 to £7 15s. 6d. f.o.b.; Bessemer steel tin-plate bars, £5 5s.; Siemens steel tin-plate bars, £5 7s. 6d., all delivered in the district cash. Tin-plates: Bessemer steel, coke, 13s. 3d. to 13s. 6d. nominal; Siemens, coke finish, 13s. 6d. to 13s. 9d., nominal. Pitwood, 19s. ex ship. London Exchange Telegram: Copper, £71 10s.; Straits tin, £113. Freights easier.

ACCORDING to an article by M. Spring, of Liège, which recently appeared in a French scientific paper, pressure alone is sufficient to cause agglomeration of the particles of all plastic metals with the formation of an alloy; thus copper and tin in the form of filings can, by pressure alone, be converted into bronze, while in the same way brass can be formed from zinc and copper. These results are explained by the assumption that a solid solution is produced at the interfaces of the contiguous particles of the different metals, and that diffusion then occurs, as has already been proved by the experiments of Sir W. Roberts-Austen on the diffusion of solid gold into solid lead. In this way molecules of the one metal pass into the mass of the other, and so a homogeneous mixture is produced. Some interesting "welding" experiments were also carried out. In one series of trials small cylinders of various metals were prepared, with their ends planed as flat as possible; they were then superimposed, in pairs, in furnaces at temperatures far below the melting point of any of the metals, and after a sufficient lapse of time the cylinders, even in the case of platinum, were found to be so completely welded that after polishing, the joint could not be detected.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, December 6th.

THE financial excitement and enormous buying movement of the past few days have subsided to some extent, but the most encouraging feature of all is the heavy buying of railway securities for permanent investment. The rate for money remains low, and there is an abundant supply. Scarcely any purely speculative movement is discernible outside of the usual profit takings of the exchanges. All necessary concessions have been made by the Colombian Government for the building of the canal. It will be bitterly opposed by the trans-continental railroad interests, which have organised a "lobby" for that purpose. The rates from New York to San Francisco are 7 dols. to 8 dols. per ton, and therefore the Bill must be defeated, say the railroad officials. They fail to recognise the economic factor that the development of the Nicaragua route will, as soon as the adjustments are made, lead to more business. The steel makers are somewhat surprised and disappointed at the partial collapse of the demand for steel during the past few days. It is largely due to the unwillingness of consumers to make extensive contracts for remote delivery. There are several reasons for this, one being the ever-present fact of expanding capacity, especially for plates and structural material. Steel rail capacity has not been increased much, but is ample for double the present demands. The railway companies manifest the same determined spirit not to pay 26 dols., despite the artificial enhancement of values. Consumers of crude steel refuse to place orders with any degree of liberality. All other branches of the industry are vigorous, though prices do not show the same vigour. Consumptive requirements are not being hurried along. Buyers wish to see further ahead. The railroad companies, as a rule, are all earning good dividends, and were material lower a much heavier mileage would be undertaken in the coming year. The exports of gold since January 1st are 48,053,543 dols.; silver, 45,359,900 dols.

CAPACITY OF FREIGHT CARS.

WHEN the introduction of freight cars carrying from 80,000 lb. to 100,000 lb. began, observing railroad officials became interested in the question of what defects were likely to manifest themselves with the immense weight carried on each axle. There was no inclination to put more than two four-wheel trucks to carry each car, and it became an interesting subject of discussion as to what weight four axles and eight wheels would carry safely. For twenty-five years the loads of freight cars have been steadily increasing. With every increase from 20,000 lb. upwards, prophets have been numerous who foretold that the limit of the carrying capacity of two four-wheel trucks had been reached; but somehow the weight was doubled and trebled without particular distress being manifested on the part of the trucks, and some people came to think that the increase of weight might go on indefinitely, so long as the parts of trucks and the axles were made sufficiently strong to carry the increase of load.

Experience with the heavy class of freight cars now in use seems to indicate that the safe limit has at last been reached. Contrary to expectation, it is not the truck or the axle that has manifested distress, but the wheel. The action of the tremendous load weight on the wheels is to destroy the cohesive power of the metal and cause breakage of the flange. It does not break under the action of sudden heavy transverse blows, but the metal at the base of the flange becomes deteriorated by the great pressure put upon it; and when this weakens the flange foundation to a certain extent, a large section—in some instances the entire flange—breaks off. The worst feature of the case is that there seems to be no remedy.

On one of the leading railroads where the heaviest cars have been largely employed, they have had a great deal of trouble with wheel flanges breaking, and heavier wheels have been introduced without any improvement being effected. Those who have given the subject close study do not believe that even steel-tired wheels will carry the weight with safety. A railroad official who has had a great deal of experience with the heavier class of cars, and is an expert on rolling stock, frankly told the writer that he believed the safe limit of weight for cars had been exceeded, and that reduction instead of increase of weight would soon become the order of the day.—*Locomotive Engineering.*

LAUNCHES AND TRIAL TRIPS.

PINNA, oil tank steamer; built by, Sir W. G. Armstrong, Whitworth, and Co.; to the order of, Shell Transport and Trading Company, Limited; dimensions, 420ft. 10in., 52ft., 33ft. 9in.; to carry, bulk oil and general cargo alternatively; engines, triple-expansion, 28in., 46in., 77in., by 48in., pressure 180 lb.; constructed by, North-Eastern Marine Engineering Company; launch, December 8th.

GAMMA, steel screw steamer; built by, Wm. Gray and Co., Limited; to the order of, B. J. Van Hengel; dimensions, 285ft., 40ft., 19ft. 3in.; engines, triple-expansion, 20in., 31½in., 53in., by 36in., pressure 160 lb.; constructed by, Central Marine Engine Works; trial trip, December 13th; 9¾ knots.

TRADE AND BUSINESS ANNOUNCEMENTS.

THE Corporation of Glasgow has, on the recommendation of its Electrical Committee, agreed to increase the salary of Mr. W. A. Chamen, the engineer in charge of the electric lighting of the city, from £800 to £1000 per annum, the increase to take effect as at 1st January next. On the recommendation of the Statute Labour Committee, Mr. Thomas Nisbet, A.M. Inst. C.E., who for the past nine years has acted as assistant master of works, has been unanimously appointed master of works of the city, at a salary at the rate of £650 per annum.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

5th December, 1900.

22,045. PROJECTILES, P. M. Staunton, Howth, Co. Dublin.
22,046. AERIAL SIGNALLING, I. Massey, Bolton.
22,047. GRAIN ELEVATORS, L. Leclerc and A. Ribandeau, Liverpool.
22,048. HEALD SHAFTS, G. M. Hocknell and H. B. Barlow, Manchester.
22,049. BLEACHING and DYEING YARN, J. Brandwood, Manchester.
22,050. COIN-FREED MECHANICAL TOY, W. C. Haigh, Manchester.
22,051. CUFF-LINKS, T. Bradbury, Manchester.
22,052. TRUING-UP SURFACES of BOWLS, D. Swires, Manchester.
22,053. STEAM TRAP, W. R. Clay, Nottingham.
22,054. CYCLE BRAKES, T. B. Bramley and The Coventry Eagle Cycle Company, Limited, Coventry.
22,055. WHEEL TIRES, W. L. Gorst, Liverpool.
22,056. PHOTOGRAPH FRAMES, F. E. Hampton, Birmingham.
22,057. HANDLES for TABLE CUTLERY, A. J. Jones, Sheffield.
22,058. COAL CONVEYORS, R. Dempster and Sons, Limited, and J. W. Broadhead, Halifax.
22,059 TREATING PRECIPITATES of COPPER, J. Tulloch, Hebburn-on-Tyne.
22,060. SCARFS, H. Allan, Glasgow.
22,061. MACHINERY for FORMING CONFECTIONS, W. H. Lamberton, Glasgow.
22,062. ROTARY PUMPS, T. Crossley and J. H. Booth, Halifax.
22,063. MEANS for COMMUNICATING MESSAGES, F. W. M. Stephenson, Halifax.
22,064. TRAY for TURNING EGGS, W. Fleming, Glasgow.
22 065. LID for HOLLOW-WARE VESSELS, T. Ansboro, Glasgow.
22,066. CORSETS and DRESS BODICES, E. Young, Glasgow.
22 067. SIMPLEX REFUSE DESTROYER, E. Willshear, London.
22,068. INSTRUMENTS for MEASURING ELECTRICAL ENERGY, A. C. Heap, London.
22,069. AUTOMATIC RAILWAY SIGNAL ALARM, S. E. Sykes and J. C. Stott, Handsworth, near Sheffield.
22,070. FURNACES, J. Murrie, Glasgow.
22,071. BOOT and SHOE DRIER and WARMER, W. H. Duffin, Aldershot.
22,072. FETTERS for PRISONERS, W. Graf, London.
22,073. MACHINES for FEEDING FIBROUS MATERIAL, C. Stott and W. H. Schofield, Manchester.
22,074. KNIFE for BRICK-MAKING MACHINES, E. M. Tymm and T. R. Slack, Marple, near Stockport.
22,075. ROTARY MOTOR, H. E. Williams, Stroud, Gloucestershire.
22,076. MELTING and APPLYING MARINE GLUE, A. Jeffery, London.
22,077. UNITING the ENDS of WARP THREADS, G. Hiller and R. Berthold, Berlin.
22,078. PURIFYING SACCHARINE LIQUORS, H. Gouthiere and Ranson's Sugar Process, Limited, London.
22,079. LASTING MACHINES, A. J. Boult.—(*United Boot Machinery Company, United States.*)
22,080. FIXING TRANSFERRING SHEET to COVER of MANIFOLDING BOOK, W. E. Coleman and F. G. Fender, London.
22,081. GOVERNING STEAM ENGINES, R. Walker and F. Hargraves, London.
22,082. HAT-PINS, A. W. Jefferson, London.
22,083. CONSTRUCTION of FURNACES, G. Hales and A. E. Paulsen, London.
22,084. ABDOMINAL BELT, F. Nusch, London.
22,085. MEMORIAL LEAVES and SHEETS, A. von Engelbrechten, London.
22,086. INSTRUMENT for HOLDING TOGETHER COLLARS, G. Mondolfo, London.
22,087. COMBINED ROAD and ICE SKATE, J. Sakrzewski, London.
22,088. INCANDESCENT GAS BURNERS, C. Gluth, London.
22,089. APPARATUS for STRETCHING TROUSERS, F. Bahre, London.
22,090. AUTOMATICALLY ACTUATING the DOORS of LIFT WELLS, A. Johanson, London.
22,091. THE LITTLE HOME FIRE-ESCAPE, M. A. Gilbert, Tonbridge.
22,092. TOY BAGATELLE, H. R. Mortell, London.
22,093. REVOLVING LASTING STANDS, I. and W. Dilley, London.
22,094. GARDEN SEATS, A. A. Tyler, W. March, and H. Penn, London.
22,095. TELESCOPIC SIGHTS for RIFLES, J. B. Lee, London.
22,096. DEVICE for FIXING the HAIR, R. Brettner, London.
22,097. BULKHEAD DOORS, J. W. Graydon and J. O. Egestorff, London.
22,098. PRODUCTION of ELECTRIC LIGHT, J. W. Graydon and J. Egestorff, London.
22,099. COOKING STOVES, J. Jagsch, London.
22,100. SHOE UPPER for MILITARY PURPOSES, G. A. Coles, London.
22,101. CIGAR for PAPER CAP TUBE, J. G. Paint, London.
22,102. WATER-TUBES for BOILERS, J. A. Armstrong, London.
22,103. HEEL TIP for BOOTS, J. B. Clark and W. Kirkland, London.
22,104. FLASH LIGHTS for INCANDESCENT GAS STREET LAMPS, W. T. Sugg, London.
22,105. STREET PAVING, A. C. W. Hobman, London.
22,106. ENGRAVING MACHINES, W. H. Lock and M. Barr, London.
22,107. MOULDS of LINOTYPE MACHINES, W. H. Lock and C. Holliwell, London.
22,108. ALUMINIUM WIRE, W. H. Hyatt, London.
22 109. DENTAL ARTICULATORS, H. Backstrom, Kingston-on-Thames.
22,110. BRAKES for ROAD VEHICLES, G. W. Cox, Kingston-on-Thames.
22,111. FEEDING WATER to STEAM GENERATORS, H. C. Needham, Kingston-on-Thames.
22,112. ROTARY ENGINES, H. S. Bell.—(*J. H. and A. A. Jackson, United States.*)
22,113. DRAIN-CLEANSING MACHINE, G. Rose, Brighton, Sussex.
22,114. CENTRIFUGAL LUBRICATORS, F. Schneider, London.
22,115. FREE-WHEEL for VELOCIPEDES, E. O. Nightingale, London.
22,116. MUSICAL INSTRUMENT, H. S. Childs, London.
22,117. FASTENING DEVICE for HATS, A. Bulbick, London.
22,118. ELECTRIC CONVEYOR, J. Baxter, O. Clark, and C. Hillman, London.
22,119. SASH LIFTER, A. E. Wright, London.
22,120. WINGS of FLYING MACHINES, A. Vergara, London.
22,121. PURIFICATION of ALKALINE CYANIDES, G. Craig and R. M. Paterson, London.
22,122. PERFUMES, O. S. Daniel, London.
22,123. NECKTIE ADJUSTERS or CLIPS and STUD, G. Smith, London.
22,124. SAFETY WINDOWS, W. H. Fowles and W. Cartwright, London.
22,125. LIQUID METERS, W. G. Kent, London.
22,126. WIRELESS TELEGRAPHY, J. A. Fleming and Marconi's Wireless Telegraph Company, Limited, London.
22,127. SIGHT MOUNTINGS for GOODS, S. H. Grubb, A. T. Dawson, and G. T. Buckham, London.
22,128. HOLDER for DENTAL APPARATUS, J. Kupfer, London.
22,129. PRELIMINARY HEATING of GAS GENERATORS, K. Groseveiler, London.
22,130. SAFETY HOOKS and EYES, W. P. Thompson.—(*T. Pedersen, Norway.*)
22,131. ARTIFICIAL TEETH, T. A. Bioletti, Liverpool.
22,132. WRINGING MACHINES, R. Walker and J. H. Brindle, Manchester.
22,133. BITS for HORSES, C. F. von Esmarch, Manchester.
22,134. TRAP for RATS, W. Zornsch, Manchester.
22,135. TIRES for VEHICLES, D. J. Ryan and R. Jones, London.
22,136. SCREW STOPPER for BOTTLES, W. H. Frank, London.
22,137. EVAPORATING APPARATUS, J. Mecredy, London.
22,138. FLUID-PRESSURE MOTOR, J. Schilhan, London.
22,139. MANUFACTURE of SLABS, L. Hatschek, London.
22,140. MEDICINAL PREPARATION, R. Boersch, London.
22,141. MECHANICAL LEVELLING APPARATUS, R. Brunck, London.
22,142. TELEPHONE RELAY, E. S. Hagemann and V. Poulsen, London.
22,143. VENTILATION of HATS, Cooper, Box, and Co., Limited, and G. Wildman, London.
22,144. EXTRACTING OIL from DISINTEGRATED NUT PRODUCTS, J. Davidson, London.
22,145. EXTRACTING OIL from SEED, J. Davidson, London.
22,146. MUSICAL BOXES, A. J. Boult.—(*H. W. Shonnard, United States.*)
22,147. WARM AIR STOVES, P. J. Ogle, London.
22,148. CARRIAGES, P. J. Ogle, London.

6th December, 1900.

22,149. BREWING TEA, D. Curr, Stretford, near Manchester.
22,150. SEWING MACHINE ATTACHMENT, W. E. Richards, London.
22,151. JUNCTION EYE for STONEWARE, J. Elrick, Sunderland.
22,152. GARDEN SEAT, A. Waddington and H. Lawson, Dewsbury.
22,153. APPARATUS for ADVERTISING, W. Henry, Gravesend
22,154. REDUCTION of SULPHIDE ORES, S. Cowper-Coles, London.
22,155. OPENING and CLOSING WINDOW SASHES, E. McGloughlin and J. and C. McGloughlin, Limited, Dublin.
22,156. SOLES and HEELS for BOOTS and SHOES, J. Cort, London.
22,157. CLEANERS for TOBACCO PIPES, P. L. Best, Walsall.
22,158. TREATMENT of BEASTS' INTESTINES, H. King, Radford.
22,159. TURBINES and WATER MOTORS, W. Antrobus, Dukinfield.
22,160. WATER-HEATING OPEN FIRE GATE, H. A. Brown, Glasgow.
22,161. ENVELOPE, A. C. Clements, Bristol.
22,162. HOLLOW LINK CHAINS, H. Pepper, Birmingham.
22,163. FLANGES of BARRELS, R. Roger, Stockton-on-Tees.
22,164. STARTING ENGINES, A. B. Brown, Glasgow.
22,165. CONSTRUCTION of WALLS, W. Cockburn, Middlesbrough.
22,166. STEAM VALVES, J., D. A., and A. Graham, jun., Glasgow.
22,167. GOLF TEE, G. M. Little, Manchester.
22,168. WAIST BELTS, P. A. Martin, Birmingham.
22,169. AIR-TUBE SHIELD BAND, A. D. Crouch, Reading, Berkshire.
22,170. TERRA-COTTA DOORSTEPS, A. J. Twamley, Hednesford, Staffordshire.
22,171. CHIMNEY-POTS, A. J. Twamley, Hednesford, Staffordshire.
22,172. CHIMNEY-POT DIES, A. J. Twamley, Hednesford, Staffordshire.
22,173. BED, TABLE, and LOCKER, C. J. Austin, Bournemouth.
22,174. BOTTLE-FILLING APPARATUS, G. W. Rowe, Manchester
22,175. TARGET GAMES, C. Jennery, London.
22,176. SANITARY SKIRT PROTECTOR, E. Cumming, London.
22,177. WALL DECORATIONS, D. M. Sutherland, Sunbury Common, Middlesex.
22,178. SYSTEM of GLAZING, C. E. Hawkins, London.
22,179. STEERING SOCKETS of BATH CHAIRS, L. L'Hollier, Birmingham.
22,180. WEIGHT-REGISTERING DEVICE, W. G. Price and L. L'Hollier, Birmingham.
22,181. CHIN RESTS for VIOLINS, C. James, London.
22,182. ELECTRICAL CONTACT MAKERS, H. G. Nicholson, London.
22,183. FASTENERS for WINDOWS, J. Redman, Halifax.
22,184. EXTINGUISHER for SAFETY LAMPS, T. L. Evans, W. Davies, G. B. Bull, and E. Owen, Cardiff.
22,185. PIANOFORTE WIRES, C. H. Alldred, Plumstead Common, Kent.
22,186. VELOCIPEDES, J. Rudge, Dursley.
22,187. MOWING MACHINE, R. W. Hussey, London.
22,188. STEAM GENERATORS, R. M. Schaffer, London.
22,189. WRENCH, M. C. Jackson and J. McDonough, London.
22,190. PREPARING TOBACCO for SALE, H. Sell, London.
22,191. MOTOR VEHICLES, G. H. Mann and J. Clayton, London.
22,192. HOOD STRETCHERS, D. and J. J. Simpson, London.
22,193. WALKING-STICK, A. W. Stockman, London.
22,194. TONGUES and LACE CLIP for BOOTS, K. J. Coram, London.
22,195. BASINS for LAVATORIES, R. W. McDonald, London.
22,196. ELECTRIC ARC LAMPS, The British Thomson-Houston Company, Limited.—(*E. Thomson, United States.*)
22,197. ELECTRIC ARC LAMPS, The British Thomson-Houston Company, Limited.—(*E. Thomson, United States.*)
22,198. INSTRUMENT for MILKING COWS, R. Caldwell, London.
22,199. BRAKE MECHANISM for CYCLES, C. Inwood, Gravesend.
22,200. PHOTOGRAPHIC CAMERAS, N. Conti, London.
22,201. CARBONISED BROMIDES, T. J. Smith, New Barnet.
22,202. SPEED GEARS, A. Pellant, London.
22,203. HYDRAULIC ENGINES, A. J. Boult.—(*A. E. Carroll, United States.*)
22 204. GOLF CLUBS, F. A. Johnson, London.
22,205. NAIL, B. Mountain and Son, Limited, and H. S. Lowe, Leeds.
22,206. GAS CARBURETTORS, A. J. Boult.—(*A. E. Grusset, France.*)
22,207. DEVICE for DESTROYING INSECTS, W. E. Darlington, London.
22,208. LEVEL INDICATOR for CASKS, C. W. H. Croker, London.
22,209. MIXING ORE, A. C. Calkins and F. W. Brann, London.
22,210. PIPE WRENCHES, E. F. Comber, London.
22,211. TOILET PAPER HOLDERS, P. F. Bunyard, London.
22,212. TELESCOPIC SIGHTS for GUNS, A. A. Common, London.
22,213. POLEHEADS for VEHICLES, A. M. Young, London.
22,214. SUBSTITUTED SULPHINIDES, G. B. Ellis.—(*Société Chimique des Usines du Rhône anciennement Gilliard, P. Monnet, et Cartier, France.*)
22,215. DOCUMENT-FILING APPLIANCE, S. G. Browne, London.
22,216. SUPPLYING AIR to FURNACES, H. McLaren, London.
22,217. SHOOTING APPARATUS, J. Francis and L. Kelsey, London.
22,218. PRINTING PLATES, D. G. MacRae and H. Soar, London.
22,219. MAKING PENCIL ERASERS, A. J. Boult.—(*La Société Anonyme des Crayons Papier of Paris, France.*)
22,220. MAKING BOOTS, G. F. Bowman and J. Branch, London.
22,221. MOWERS, W. F. Johnston, F. D. Mercer, and J. Stephenson, London.
22,222. MACHINE for GUMMING ENVELOPES, T. B. Kendell, London.
22,223. REDUCING VALVES, F. M. Kramer, London.
22,224. WARNING SHIPS of ROCKS, L. Daft and A. Williams, London.
22,225. DRIVING GEAR for MOTOR CAR, A. E. Fornasari, London.
22,226. AUTOMATIC GAS LIGHTERS, C. E. J. Berthold, London.
22,227. SINKING and BORING MECHANISM, J. Vogt, London.
22,228. CLIP, E. G. Hutchings, London.
22,229. BEDPANS, J. Houghton, Liverpool.
22,230. ELECTRIC CONDUCTORS, W. J. Glover, Liverpool.
22,231. TOBACCO PIPES, J. and W. L. Smith, Liverpool.
22,232. CONSTRUCTION of ANCHORS, S. Grainger, Birmingham.
22,233. ELECTRICAL TRAMWAYS, &c., C. Kandó, London.
22,234. AUTOMATIC ELECTRIC RELAYS, C. Kandó, London.
22,235. APPARATUS for PRODUCING DESIGNS, A. Hofman, London.
22,236. SMOKE-CONSUMING FURNACES, W. Dürr, London.
22,237. MEASURING PRESSURE of LIQUIDS, M. Schubert, London.
22,238. FASTENING RING, C. Chenu and L. Gautreau, London.

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22,239. STUFFING-BOX PACKINGS, P. Redford, Marple, Derbyshire.
22,240. REFINING of METALS, S. Cowper-Coles, London.
22,241. SPINNING MULES, C. W. Buckley and A. Bradley, Manchester.
22,242. DRAUGHT EXCLUDER for DOORS, H. J. Harris, Bradford.
22,243. METHOD of PACKING TAPE, H. J. Bonas, Derby.
22,244. TILES for ROOFS of BUILDINGS, F. Swallow, Hull.
22,245. CRANES, W. R. Green, Newcastle-on-Tyne.
22,246. STEREOSCOPIC EFFECTS, C. A. Burghardt and A. V. Hunt, Manchester.
22 247. PROCESS for PRESERVING GRAIN, E. T. Mellor, Southampton.
22,248. RANGE-FINDING INSTRUMENTS, J. Waddell, Glasgow.
22,249. VELOCIPEDES, P. L. and J. Renouf, Erdington, near Birmingham.
22,250. PRODUCING COLOURED MAPS, T. C. Bramah, Edinburgh.
22,251. CASH TILLS, G. H. and A. H. Gledhill, Halifax.
22,252. BLEACHING TEXTILE GOODS, C. L. Jackson and E. W. Hunt, Manchester.
22,253. ELECTRIC SWITCHES, E. T. Parker, Wolverhampton.
22,254. MOULDING DOUGH into LOAVES, H. Black, Glasgow.
22,255. HEATING and VENTILATING SHIPS, T. Scotland, Glasgow.
22,256. HEATING and VENTILATING SHIPS, T. Scotland, Glasgow.
22,257. HEATING and VENTILATING SHIPS, T. Scotland, Glasgow.
22,258. HEATING and VENTILATING SHIPS, T. Scotland, Glasgow.
22,259. FLUID-PRESSURE HEAT MOTORS, P. Pinkney, Swansea.
22,260. AUTOMATIC RELEASE for GAME, D. E. Hipwell, London.
22,261. FURNACES for HEATING RODS, &c., J. Crosher, Glasgow.
22,262. MEANS for DECORATING CAKES, T. Ferguson, Glasgow.
22,263. CINDER SIFTER and HEARTH TIDY, E. Pearson, Southport.
22,264. BOX, F. Davenport, Leek, Staffs.
22,265. SADDLES, W. Robins, London.
22,266. WASHING MACHINE, J. F. Watson, A. Watson, jun., and W. B. Watson, Stockton-on-Tees.
22,267. CONTRIVANCE for ALTERING SIZE of BELTS, L. Davis, London.
22,268. MEASURING VOLATILE SPIRITS, C. C. H. Cadge, London.
22,269. TOY, F. J. Satchwell, London.
22,270. CENTRIFUGAL MACHINES, R. Schultze, London.
22,271. ADJUSTABLE NIPPLE WRENCH, H. Wingfield, London.
22,272. GALVANOMETERS, T. E. and C. T. Gambrell, London.
22,273. ELECTRICAL PLUG RESISTANCE BOXES, C. T. and and T. E. Gambrell, London.
22,274. LABEL and TABLET HOLDERS, D. T. Tomey Birmingham.
22,275. GRINDING MACHINES, G. A. and C. Garrett, and D. Ballach, Sheffield.
22,276. CLIP for LADIES' DRESSES, L. Cross, London.
22,277. GAS BOILERS, W. Schmitz, London.
22,278. DEVICE for HOLDING MATCHES, H. F. Moulding, Burnley.
22,279. MOULDING HOLLOW CASTINGS, H. N. Davis, London.
22,280. NIGHT LATCHES, N. J. and J. E. Jones, Birmingham.
22,281. SUSPENDING ELECTRIC LAMPS, E. Fletcher, Birmingham.
22,282. MOULDERS' CORE BOXES, &c., H. N. Davis, London.
22,283. CONTROLLING ACTION of VALVES, H. Davy, London.
22,284. SPEED GEAR for BICYCLES, W. G. B. Tyrrell, London.
22,285. ELECTRICAL VEHICLES, The British Thomson-Houston Company, Limited.—(*S. B. Stewart, United States.*)
22,286. ELECTRICAL SWITCHES, The British Thomson-Houston Company, Limited.—(*W. B. Potter, United States.*)
22,287. SYNCHRONISING APPARATUS for ELECTRIC ALTERNATORS, The British Thomson-Houston Company, Limited.—(*F. T. Doe, United States.*)
22,288. ATTACHING POLE-PIECES to ELECTRIC MACHINES, The British-Thomson Houston Company, Limited.—(*H. G. Reist, United States.*)
22,289. MEDALLIONS, K. Antritter, London.
22,290. TELEPHONE APPARATUS, S. G. Brown, London.
22,291. CONVERTIBLE CYCLES, H. V. Weyde, London.
22,292. SECURING TIRES to WHEELS, W. F. Williams, London.
22,293. CIGAR HOLDERS, T. J. Denny, Lee, Kent.
22,294. AUTOMATIC SPRINKLERS, H. Stephens, London.
22,295. COUNTING APPARATUS, I. Goerlich, P. and O. Zeike, London.
22,296. SEWING MACHINES, H. H. Lake.—(*D. Noble, United States.*)
22,297. SULPHONIC ACID, H. H. Lake.—(*K. Oehler, Germany.*)
22,298. SINKING SHAFTS, H. R. J. Portier, London.
22,299. COIN-FREED APPARATUS, E. Roussey, London.
22,300. HEATING AIR in FACTORIES, H. H. Lake.—(*L. Scomfetti, Italy.*)
22,301. FENDERS for VEHICLES, W. A. McGuire, London.
22,302. FLOORS, E. H. Bell, London.
22,303. TILES, E. H. Bell, London.
22,304. LUBRICATORS, J. Knell-Senn and H. Knell-Meier, London.
22,305. SLUICE GATES, H. J. Haddan.—(*J. E. Whiting, India.*)
22,306. WINDING FRAMES, W. Reiners, London.

22,307. REMOVABLE INSULATING COVERINGS, H. F. A. Edmonds and S. J. Tungay, London.
22,308. SPORTING GARMENTS, A. G. Hulme-Beaman, London.
22,309. COMBINATION FIRE-IRON, A. G. Lamb, London.
22,310. NIGHT-DRESSES, M. B. Middlemass, London.
22,311. DOORS, J. C. Moore, London.
22,312. BELTING for MACHINERY, W. P. Thompson.—(*T. Zima, Austria.*)
22,313. LAMINATED CORES for ELECTRICAL APPARATUS, A. N. Thorin, London.
22,314. ADJUSTABLE SUPPORT for LADDERS, G. Meyer, London.
22,315. BEVEL, V. Reisewitz, London.
22,316. ELECTRIC CABLES, W. J. Glover, Liverpool.
22,317. FLYERS for SPINNING YARNS, C. S. McConnan, Liverpool.
22,318. LAWN MOWING MACHINES, F. W. Follows, Manchester.
22,319. KNIFE-CLEANING MACHINES, F. W. Follows, Manchester.
22,320. POT-TEEMING APPARATUS, J. W. Cruikshank, London.
22,321. COIN-FREED FRANKING DEVICES, H. H. Leigh.—(*C. H. Kahrs and M. Lea, Norway.*)
22,322. RESILIENT TIRES, W. E. Carmont, London.
22,323. COPING BRICKS, W. Foxton, London.
22,324. FIRE-BLOWERS and FIRE-SCREENS, P. Grayson, London.
22,325. SPEED INDICATORS for VEHICLES, H. E. S. Holt, London.
21,326. CLOSURES for BOTTLES, G. W. Johnson.—(*A. L. Weissenthanner, United States.*)
22,327. DEVICE for BUDDING PLANTS, F. J. E. Vollstedt, London.
22,328. BIACETATE of ANTHRAPURPURIN, W. L. Wise.—(*Knoll and Co., Germany.*)
22,329. SALICYLOLYCOLIC ACID, W. L. Wise.—(*Knoll and Co., Germany.*)
22,330. ALTERNATING CURRENT MEASURING INSTRUMENTS, W. M. Mordey, London.
22,331. STEAM SEPARATOR, R. Maggs, London.
22,332. DEVICE for CUTTING STRING, R. Nettell, jun., London.
22,333. DOUGH-MOULDING MACHINE, F. T. Farrer, London.

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22,334. CATERPILLAR GHOST TRAP, G. H. Ball, Penzance.
22,335. UNIONS, R. H. Shephard, London.
22,336. BLUE FLAME ATMOSPHERIC OIL BURNER, C. Scouller, Glasgow.
22,337. AFFIXING PINS to BROOCHES, S. T. Rudge, Swindon.
22,338. VALVELESS SELF-CLOSING TIRE, E. H. Beal, Southsea.
22,339. PRESSES, W. Wall, Bradford.
22,340. PROTECTOR for TRAMS, J. Whitehead, Birmingham.
22,341. MACHINE for WASHING COAL, R. P. Slinger and C. H. Cadman, Ilkley, Yorks.
22,342. MECHANICAL TOYS, F. J. and W. L. Bullows, London.
22,343. METALLIC TUBES, J. L. Wright, London.
22,344. MAGAZINE FIRE-ARMS, G. M. C. Brand, Glasgow.
22,345. MOULDING, A. Watson, Sutton Coldfield, Warwickshire.
22,346. CHOPPING BOARDS, W. J. Anthony, Birmingham.
22,347. CHANGE SPEED GEARING, F. E. Baron, Manchester.
22,348. GEAR for BELTING, T. Hill, Willenhall, near Wolverhampton.
22,349. STEAM STOP VALVES, G. Cockburn, Glasgow.
22,350 SKATE BORING APPLIANCES, W. Gordon, Glasgow.
22,351. CYCLE TREADLE BEARINGS, H. Nawigk, Cologne.
22,352. SHRAPNEL SHELLS, H. D. Rattray and J. S. Kershaw, Rochdale.
22,353. STRAP GRIPS for SNAFFING, J. H. Wallace, Glasgow.
22,354. CONDENSERS, G. W. Blackburn, Leeds.
22,355. STEEL-FACED LEVELLING STAFF, H. Couling, London.
22,356. SIDE DOORS for RAILWAY WAGONS, J. Waldie and R. Y. Pickering and Co., Ltd., Wishaw, Lanarkshire.
22,357. ANTI-RHEUMATIC LEGGINGS, A. Coopersmith, London.
22,358. BURNISHING METAL, J. C. Staples and T. F. Westley, London.
22,359. DISCHARGING GRAB, F. Pluck and S. W. Hart, London.
22,360. WIRELESS ELECTRIC TELEGRAPHY, P. A. Cain, London.
22,361. SOLES of BOOTS, J. D. Fulcher and A. Burton, London.
22,362. INDUCTORS, V. I. Feeny.—(*Allgemeine Elektricitäts Gesellschaft, Germany.*)
22,363. TROUSER PRESS or STRETCHER, N. W. H. Sharpe, London.
22,364. COLOUR LITHOGRAPHY, E. Akester, J. Johnson, and G. A. Goodwin, London.
22,365. LITHOGRAPHIC STONES, E. Akester, J. Johnson, and G. A. Goodwin, London.
22,366. VAPORISED OIL, H. Thornton and E. F. Chapman, London.
22,367. TOBACCO PIPE CLEANERS, C. E. Edmonds, London.
22,368. BOILERS, C. S. Rolls, N. D. Macdonald, and A. D. Smith, London.
22,369. ORDNANCE TELESCOPE, A. Richwald.—(*F. Krupp, Germany.*)
22,370. FILES, W. C. Grant, A. S. Sachamaille, and F. W. le Tall, London.
22,371. IMPROVED BUTTON or STUD, J. A. Crane, Birmingham.
22,372. DISCHARGING ELECTRIFIED WOOL, J. G. White and Co., Limited, and J. G. White, London.
22,373. SHIFTING POINTS of TRAMWAYS, M. Barth, Liverpool.
22,374. KNIFE-CLEANING MACHINES, F. W. Follows, Manchester.
22,375. SCAFFOLDING LADDERS, J. O. O'Brien.—(*Galiazzo and Cristilli, Italy.*)
22,376. SAFETY GEAR for FORCE PUMPS, G. F. Strawson, London.
22,377. AGITATING DEVICE for LIQUIDS, G. F. Strawson, London.
22,378. DRYING APPARATUS for ELECTRICAL INSULATING MATERIALS, E. A. Claremont, London.
22,379. ELECTRICAL INSULATING MATERIALS, E. A. Claremont, London.
22,380. VOTING MACHINES, A. J. Boult.—(*F. F. Church, United States.*)
22,381. VOTING MACHINES, A. J. Boult.—(*F. F. Church, United States.*)
22,382. MACHINERY for FILLING RECEPTACLES with a GIVEN WEIGHT of GROUND SUBSTANCES, J. P. Pattison, Birmingham.
22,383. BANDS with BUTTONHOLES, A. B. Bischoffshausen, London.
22,384. DRESSES for DIVERS, F. H. Sprang, London.
22,385. FILMS for PHOTOGRAPHIC PURPOSES, P. A. Newton.—(*Bunt and Luxurpapierfabrik Goldbach, Germany.*)
22,386. LETTERPRESS COPYING SHEETS, W. Foxton, Scarborough.
22,387. FEEDING PRINTING MACHINES, W. Vickery, Norfolk.
22,388. INCANDESCENT PILE, J. Blaichrode, London.
22,389. EXTRACTING GOLD from SEA WATER, J. F. Duke, London.
22,390. BLOCKS for PRINTING FLOORCLOTH, A. T. Woodhead, London.
22,391. PHENYLDIMETHYLPYRAZOLONE, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
22,392. ROWING BOATS, P. Hampel, London.
22,393. DRAUGHT MANTLE for OIL LAMPS, A. Layland, London.
22,394. PISTON for SUPERHEATED STEAM ENGINES, E. König, London.
22,395. ENAMELS for METALS, H. H. Lake.—(*O. Leproux, France.*)
22,396. FLUID-PRESSURE ENGINES, E. T. Adams, London.
22,397. NEW COLOURING MATTERS, H. H. Lake.—(*K. Oehler, Germany.*)
22,398. CUTTING CLOTH, H. Lotery, M. Bromet, and F. Leslie, London.
22,399. LUBRICATING CROSSHEAD PINS, W. J. Harvey and W. H. Wheaton, London.
22,400. LEVER MEAT HOLDER, J. Dobson, Oldham.
22,401. ILLUMINATING BODIES for ELECTRIC LIGHTING, E. Sander, London.
22,402. PRINTING TEXTILE MATERIALS with INDIGO, B. Willcox.—(*The Badische Anilin and Soda Fabrik, Germany.*)
22,403. LIGHTING TRAINS, J. Woodside and F. Wilson, London.
22,404. FLUSHING CLOSETS, J. Croppi and L. Edant, London.
22,405. DRESSING BAGS, J. and R. J. Foot, London.
22,406. DECOMPOSITION of SALTS, J. Greenwood, London.
22,407. SOLVING ASTRONOMICAL PROBLEMS, J. L. Moore, London.
22,408. MAKING IRON, P. M. Justice.—(*S. Talbot, United States.*)
22,409. PIPES for SMOKING TOBACCO, J. G. Sinclair, London.
22,410. BUFFER and DOOR CATCH, T. Drew, Manor Park, Essex.
22,411. ELECTRIC STREET TRAMWAYS, W. B. Sayer, London.
22,412. TARGETS, A. F. Dobbs and F. C. Grimley, London.
22,413. RECORD PLATE for GRAMAPHONES, T. Birnbaum, London.

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22,414. EXTRACTING ZINC, T. P. Sims and H. Martin, Swansea.
22,415. STENTERING MACHINE, C. L. Jackson and E. W. Hunt, Manchester.
22,416. FIRE LIGHTERS, T. Sutcliffe, Bradford.
22,417. GUTTERS for USE in STABLES, J. K. Ford, Derby.
22,418. SURFACING of PAPER, The Westfield Paper Company, Ltd., and G. Stewart, Glasgow.
22,419. TABLET for WINE BOTTLES, B. D. Connochie, Glasgow.
22,420. WEAVING LOOMS, J. Eastham and G. Adcroft, Halifax.
22,421. STEAM SUPERHEATERS, J. Howden, Glasgow.
22,422. CYCLE BRAKE, A. J. and A. Vann, Birmingham.
22,423. SPEED of VESSELS, A. A. Hely, Bognor-on-Sea.
22,424. FRAMES for TABLEAUX, &c., V. W. Rowe, London.
22,425. LOCKING TROLLEYS and TRUCKS, C. J. Richards, London.
22,426. APPARATUS for FILTERING OIL, H. Trevor, Manchester.
22,427. RUBBER TIRES for WHEELS, J. Barber, Manchester.
22,428. GEOMETRICAL DRAWING DEMONSTRATORS, J. Rennie, Glasgow.
22,429. SEATS for RAILWAY STATIONS, E. J. Alford, Bury.
22,430. PLOUGHS, D. Magill and R. Verner, Glasgow.
22,431. DEVICE for OPENING ENVELOPES, J. L. Fenton, Burnley.
22,432. ATTACHING WHEELS to CYCLES, J. G. Morris, London.
22,433. ELECTRICAL CONDUITS, L. M. Waterhouse and The Simplex Steel Conduit Company, Ltd., Liverpool.
22,434. METALLIC CONDUITS, L. M. Waterhouse and The Simplex Steel Conduit Company, Ltd., Liverpool.
22,435. DEVICE for SPRAYING POTTERY, S. A. Jones, Burslem.
22,436. FORGING NUTS, W. Bennett and W. Halliwell, Manchester.
22,437. CONSTRUCTION of BEDSTEADS, T. W. Adshead, Birmingham.
22,438. RACK for PLATES, J. H. Lewis and R. E. Gold, Bristol.
22,439. KNICKER and other BUCKLES, T. J. Wilson, Dublin.
22,440. DRY-HOPPING MACHINERY, T. Hyde, Manchester.
22,441. GAMES of CHESS and DRAUGHTS, F. W. Foss, Swindon.
22,442. MATS, G. H. Ellis, Northwood, R.S.O., Middlesex.
22,443. BILLIARD MARKING REGISTER, C. D. Barker, London.
22,444. STEERING AERIAL MACHINES, G. Grant, London.
22,445. MECHANICAL ADVERTISING DEVICE, E. C. Wild, London.
22,446. METHOD of DRIVING NAILS, &c., E. Hart, London.
22,447. LIGHT LOCOMOTIVES, W. W. Beaumont, London.
22,448. ADVERTISING APPARATUS, E. Picard, London.
22,449. PHOTOGRAPHIC STUDIOS, H. H. Lake.—(*C. Bernhoeft, Luxembourg.*)
22,450. MACHINE for STONING FRUIT, O. M. Wolff, London.
22,451. POLE PIECES SPREADER, F. S. B. Mallett, London.
22,452. AUTOMATIC POTENTIAL REGULATOR for DYNAMOS, N. Browne.—(*The Tirrill Regulator Company, United States.*)
22,453. SHOES for COVERING the FEET, G. Wildman, London.
22,454. WATER COLOUR SKETCHING BLOCKS, F. Papillon, London.
22,455. BLACK COLOURING MATTERS, C. D. Abel.—(*Actien Gesellschaft für Anilin-Fabrikation, Germany.*)
22,456. SULPHONATED COLOURING MATTER, C. D. Abel.—(*Actien Gesellschaft für Anilin-Fabrikation, Germany.*)
22,457. SHEDDING MOTION for LOOMS, G. Schwabe, London.
22,458. MANUFACTURE of BUTTER, &c., M. Poppe, London.
22,459. PICKS, H. S. Bell.—(*I. Price, J. O'Melia, and W. B. Martin, United States.*)
22,460. AUTOMATIC HAT HOOK, E. M. Edwards, Leytonstone.
22,461. COMBING MACHINES, E. and E. Meunier, London.
22,462. CATCHING BIRDS, A. J. Boult.—(*F. R. Radestock, Germany.*)
22,463. CUSTOMERS' BOOKS for BAKERS, W. H. Rippin, London.
22,464. CONNECTING DRIVING BELTS, A. D. Lagrelle, London.
22,465. TREATING FEVER PATIENTS, J. G. Bennet, London.
22,466. LEG COVERINGS for CYCLISTS, F. Feeney, Manchester.
22,467. COUPLINGS for HOSE PIPES, J. Morris, jun., Manchester.
22,468. DOUBLE-BAR HOOK for HOISTING PIGS, J. Matterson, London.
22,469. RIM BRAKES for CYCLES, J. R. Trigwell, London.
22,470. GAS LIGHTING, O. A. Berend.—(*J. R. Schauer, Bohemia.*)
22,471. CATARACTS for ENGINE VALVE GEAR, F. Elsner, London.
22,472. BOOTS, The London Shoe Company, Limited, and J. Weaver, London.
22,473. LOWERING SHIPS' BOATS, A. Welin, London.
22,474. VARIABLE SPEED GEARING for CYCLES, F. Deschamps, London.
22,475. STEERING GEAR for MOTOR CARS, F. Deschamps, London.
22,476. STAPLES for ELECTRIC WIRES, H. A. Lits, London.
22,477. STOPPERS for BOTTLES, J. Simon, London.
22,478. STEAM GENERATORS, W. Hornsby, D. Roberts, and C. James, London.
22,479. STEAM GENERATORS, W. Hornsby and D. Roberts, London.
22,480. LETTER REGISTERS, P. Kotzian, London.
22,481. KEEPING COOL the BARRELS of GUNS, W. H. FitzGerald, London.
22,482. OBTAINING ALKALINE CYANIDES, G. Craig and R. M. Paterson, London.
22,483. RAILWAY TRAFFIC CONTROL SYSTEMS, W. Rowe, London.
22,484. PREPAYMENT ELECTRICITY METERS, E. Schattner, London.
22,485. STEAM VACUUM PUMPS, E. B. Rayner, London.
22,486. EDUCATIONAL APPLIANCES, A. M. Hartzer, London.
22,487. MANUFACTURE of TUBES, F. Gandy and The Staveley Coal and Iron Company, Limited, London.
22,488. PRODUCTION of DRY ALKALINE SILICATE, C. Reim, London.
22,489. MEASUREMENT of FLUIDS, C. F. Marsh, London.
22,490. FURNACES, S. T. Bleyer, London.
22,491. INCANDESCENT GAS BURNERS, C. Carpenter, London.
22,492. FITTING PEGS to INCANDESCENT GAS BURNERS, C. Carpenter, London.
22,493. MOUNTING MAPS, A. Hesse and G. A. Krieger, London.
22,494. COIN-FREED GAMES of SKILL, G. Haydon, London.
22,495. SAFETY DOORS for WELLS, A. Lamprecht, London.
22,496. MATRIXES for STEREOTYPING, L. Elias, London.
22,497. DRAINAGE GULLIES, J. Wattmann, London.
22,498. REMOVING LEAVES from WATER SUPPLY to MOTORS, L. Parsons, London.
22,499. MECHANICAL GLAZING BARS, D. J. Jarvis, J. W. Wadkin, and T. S. King, London.
22,500. WARDROBE TRUNKS, T. J. Hamilton, London.
22,501. SHRAPNEL SHELLS, R. Fiedler, London.
22,502. BOOTS, A. H. Mastin and R. Burman, Hastings.

11th December, 1900.

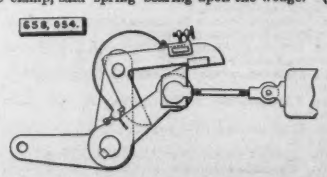
22,503. CONTACT SWITCH, F. and W. Atkinson, Leeds.
22,504. BAKERS' FITTINGS, T. Barker, Manchester.
22,505. TOY, G. R. James, Liverpool.
22,506. PROPELLING CYCLES, F. F. Mote and H. E. Ward, King's Lynn.
22,507. IGNITER for INTERNAL COMBUSTION ENGINES, A. G. New, Woking.
22,508. ELECTRICAL RESISTANCE SWITCH, J. Cusworth, Newcastle-on-Tyne.
22,509. PROTECTOR for SPARKINGS of MOTORS, C. H. Guest, Ockbrook, Derbyshire.
22,510. ATTACHMENTS for WIRE ROPES, W. H. Becker and R. Williams, Cardiff.
22,511. LEAD PENCILS, W. J. Berry, Sheffield.
22,512. MULE HAIR CLIPPERS, L. C. Brown, Birmingham.
22,513. WATER CIRCULATORS for BOILERS, E. W. Wynne, Liverpool.
22 514. BARREL TAPS, J. T. Monks, Manchester.
22,515. TOLLING CONTACT for ELECTRIC BELLS, A. B. Mudie, Birmingham.
22,516. BABY CHAIRS, H. D. Fitzpatrick, Glasgow.
22,517. ROCKING CHAIRS, H. D. Fitzpatrick, Glasgow.
22,518. FLAT-BOTTOM EXTENSIBLE BOATS, A. Austin, London.
22,519. REGULATOR for WATER WHEELS, J. W. Macfarlane, Glasgow.
22,520. HEAT DEFLECTORS for GAS COOKING STOVES, J. Hammond, Coventry.
22,521. MARINE NIGHT SIGNALLING, G. Cawley, Cribbs Causeway, near Bristol.
22,522. SELF-FIXING BEAD for CHIMNEYPIECES, T. Blundell, Gloucester.
22,523. CHANGING SHUTTLES in LOOMS, A. Smith and S. Jackson, Keighley.
22,524. RECEPTACLES for MATCHES, H. Path, Paris.
22,525. BICYCLE MOTORS, E. Boillod, Paris.
22,526. EASELS, L. Andrieu, Paris.
22,527. VENTILATING CHURCHES, W. F. McGibbon, Glasgow.
22,528. SEWING MACHINES, J. K. Macdonald.—(*The Singer Manufacturing Company, United States.*)
22,529. BURNERS for HEATING APPARATUS, J. E. Nyqvist, K. T. Söderberg, and H. T. Almstedt, Glasgow.
22,530. FEEDING BOTTLE for INFANTS, W. M. Storrar, Belfast.
22,531. MACHINES for CUTTING PAPER, J. Jamieson, Edinburgh.
22,532. BLACKING BRUSH, W. Cooper and A. Arthurs, Bristol.
22,533. FORKS for BICYCLES, P. G. Leyden, Pontardawe, Glam.
22,534. NON-SLIPPING HORSESHOE, A. J. N. and W. Goodson, Leighton Buzzard, Beds.
22,535. POCKET KNIFE, W. Macrae, Bridlington.
22,536. DEVICE for REVERSING SPEEDS, F. Coxon, Smethwick.
22,537. ROAD-ROLLER SCARIFIER, B. Asplen, London.
22,538. SKIRT WRIGHT and PROTECTOR, H. Smith, London.
22,539. TYPEWRITERS, A. J. Boult.—(*F. Salgwick, United States.*)
22,540. MACHINE for SWEEPING STREETS, W. Hight, London.
22,541. BILLIARD TIME INDICATORS, M. Bernstein, London.
22,542. SUPPORTING ELECTRIC LAMPS, A. Richter, London.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

658,054. SPRING TENSION DEVICE for VALVE GEAR, *L. G. Wulbern, Birmingham, Ala.*—*Filed April 5th*, 1900.

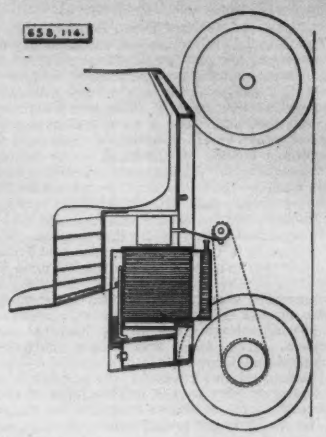
Claim.—(1) The combination with a claw and spring of the valve gear of an engine, of a clamp secured to said claw, an upright thereto, a screw keyed within the upright, a wedge upon the claw engaged by the screw, and means for holding the wedge in position within the clamp, said spring bearing upon the wedge. (2



The combination with a claw and spring of the valve gear of an engine, of a clamp secured to said claw, an upright thereto, a screw keyed within the upright and revoluble therein, a wedge slidable upon the claw, an arm thereto engaged by the screw, and flanges upon the sides of the wedge adapted to slide within the clamp, said spring bearing upon the wedge.

658,114. FLUE CONSTRUCTION for STEAM CARRIAGES, *R. C. Mudge, New York, N.Y.*—*Filed April 30th*, 1900.

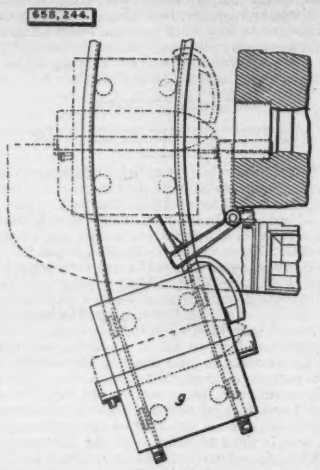
Claim.—The combination with a carriage body, of a steam boiler carried thereby and having a burner for heating it, and a flue for disposing of the products of combustion from the burner, said flue having substantially-horizontal divergent branches extending transversely of the carriage body and terminating in outlets to the atmosphere which coincide substantially with the planes of the side walls of the carriage body, said branches being arranged on either side of that portion of the flue which connects with the flues or heating passages of the boiler, and together forming a through passage for disposing of atmospheric currents



which might otherwise reverse the normal draught of the burner.

658,244. APPARATUS for SUPPLYING CHARGES to HEAVY TURRET or BARBETTE GUNS, *A. T. Dawson, London, and J. Horne, Barrow-in-Furness, England.*—*Filed March 20th*, 1900.

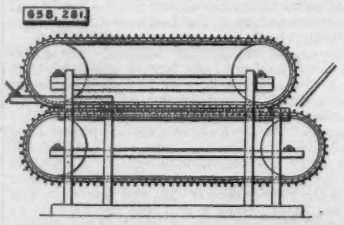
Claim.—In an apparatus for supplying charges to turret or barbette guns, the combination of a turntable carrying one or more guns, and a trunk or lift shaft suitably attached to the said turntable, of a cage travelling upon the said trunk and provided with a tray at its top, a pair of inclined and curved guide



rails, a cage *g* adapted to travel upon the said guide rails, and provided with a cam bar, a trough interposed between the cage travelling upon the trunk and the said guide rails and adapted to automatically receive a projectile from the cage upon the trunk and deliver it to the cage which travels upon the guide rails, and a loading tray connected to the loading arm of each of the said guns and operated by the said cam bar.

658,281. MACHINE for TREATING PEAT, *A. Rom, Lian, Norway.*—*Filed March 18th*, 1899.

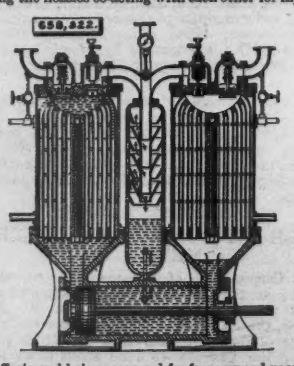
Claim.—In a machine of the class described, the combination of two endless belts, one of said belts having teeth of lenticular form in section blunted at their rear edge, and the other, teeth of ellipsoidal form in section working between said lenticular teeth,



the teeth on both belts set to leave considerable space between them, and means for driving the co-operative portions of said belts in one and the same direction, the upper belt travelling at a greater speed than the lower one, substantially as and for the purpose set forth.

658,322. AIR COMPRESSOR and COOLER, *O. P. Ostergren, New York, N.Y.*—*Filed March 23rd*, 1900.

Claim.—The combination with an air compressor, of an aqueous vapour separator consisting of the upright hollow cylinder receiving the compressed air at the top and containing injector devices consisting of the two series of funnels, the funnels of one series having the nozzles co-acting with each other for inject-



ing effects and being arranged for free upward passage of the air around them and the funnels of the other series adapted to cause the up-flowing air to converge over the upper ends of the funnels having the nozzles, to favour separation of the aqueous vapour, the respective funnels of each series being placed intermediately of the funnels of the other series.

CENTRAL AMERICAN SHIP CANALS.

No. VI.

THE United States Congress in 1895 authorised the President to make a "preliminary survey" of the Nicaragua route, and, to pay for the work, appropriated the magnificent sum of £5000. Lieutenant-Colonel Ludlow, of the United States Engineer Corps, was placed at the head of the Commission, and in a short time reported that the project was "feasible." The Commission approved of the general plan of the Maritime Canal Company, but recommended its modification in certain particulars, and increased the minimum estimate of cost to £26,700,000. It also expressed an opinion that further and more elaborate and minute surveys should be made, and that data as to the rainfall, the flow of the Rio San Juan, and the variations of the summit level of Lake Nicaragua were desirable—not, it was carefully pointed out, to make certain the possibility of constructing the canal, but to assist in framing more precise estimates of cost and aid in the selection of routes, where choice was possible, over part of the distance. Accordingly, Congress in 1897 appropriated 150,000 dols., authorised the President to appoint another Commission, and directed that full and complete surveys should be made, and that all available information should be collected to enable the Commission to arrive at "correct conclusions" as to the feasibility of the enterprise, its early construction, and cost. In due course the President nominated a Commission, consisting of Rear-Admiral Walker, Prof. Lewis M. Haupt, a civil engineer, and Col. P. C. Hains, of the Engineer Corps, U.S.A. These gentlemen spent some time in the isthmus, and in June, 1898, gave evidence at considerable length before a select committee of the Senate, which at that time had under consideration the Bill, to which reference has already been made, to "buy out" the Maritime Canal Company. They also in the following December issued a preliminary report, in which the three members concurred as to the superiority of the Lull route as compared with that adopted by the Maritime Company,

because it is easier of construction, presents no problems not well within good engineering precedents, and will be a safer and more reliable canal when completed. It—the Commission—also believes that the dimensions and form of construction preferred are better than the cheaper form with smaller dimensions, which would undoubtedly call for expensive improvements within a short time after its completion.

Admiral Walker and Mr. Haupt estimated the cost of constructing a canal over the respective routes at 124,000,000 dols. and 123,000,000 dols., but their colleague reported,

in view of the increased size of the canal estimated for, and the difficulties incident to work in tropical climates, that the estimate is lower than it should be by about 20 per cent.

Little opportunity was afforded to the three members of this Commission—officially described as the Nicaragua Canal Commission, but more familiarly known as the Walker Commission—to prepare the complete report promised by them in December, 1898; for within four months another and larger body was appointed to investigate *de novo* and exhaustively the entire question. Thenceforward until the present month no formal statement has emanated from official quarters, though many far from propitious rumours have circulated concerning the difficulties encountered and the repeated failures to arrive at satisfactory solutions. In face of the findings of the Ludlow Commission and their own evidence before the Senate Committee, it is matter for marvel that the members of the Walker Commission should have hazarded the statement that the route favoured by them presented "no problems not well within engineering precedents." Very few words will suffice to show how far this assertion was justified by facts.

Both the Ludlow and Walker Commissions recognised the extreme difficulty of regulating the level of Lake Nicaragua, so as to avoid, on the one hand, the flooding of a valuable region on the Pacific side, or, on the other, the exposure of rocks in the bed of the upper San Juan, where, before a canal is possible, several dangerous rapids must be drowned or excavated. As will be seen from the map, the project of the Maritime Company included two principal dams—one at Ochoa, and the other, 70ft. high, at La Flor, west of the lake. The La Flor dam, however, was condemned as impracticable by the Ludlow Commission, and regarded with scant favour by Admiral Walker, Colonel Haines, and Mr. Hampt. As originally planned, the Ochoa dam was to have an average height above the river bottom of 61ft., to be 25ft. wide at the top, and 500ft. wide at the bottom, and to measure 1250ft. along the crest, irrespective of abutments. Under the most favourable conditions, such a work could not fail to offer many difficulties, though not a single one was suggested in the reports of the Maritime Company. Although the Walker Commission is stated stated to have found at Ochoa a rock bottom at great depth, estimated by the Admiral at 40ft. or 45ft., and by Mr. Haupt at 60ft. below sea level, or 80ft. to 85ft. and 100ft. respectively below the centre of the river bed, it presented no approach to a definite plan for the construction of the dam. The embankment of loose rock and clay, which was the expedient proposed by the Maritime Company, was characterised by Admiral Walker as equivalent to "moving a hill into a river." It, however, would have been both easy and safe as compared with the only alternative suggested—first, the excavation of 80ft. to 100ft. to reach rock foundations in the bed of a river which cannot be temporarily diverted, and then the construction upon this newly-discovered and somewhat doubtful base of a mass of masonry rising 160ft.

Objections quite as serious applied to the "minor" structures required to support the summit level. In the Ludlow report one finds mention of no fewer than 132 such structures—locks, dams, weirs, sluiceways, and embankments, and of these half were projected in the San Francisco basin. The San Francisco embankments were admitted by the engineer-in-chief of the Maritime Company to be "the weakest feature of the whole route," and were thus described by the Ludlow Commission:—

The total number of embankments is no less than sixty-seven, with a total crest length of six miles. The longest of these is the San Francisco, with a crest length of 1·2 miles, an extreme height above the river of 85ft. There are five others—from 1040ft., with greatest height of 60ft., to 1840ft., with height of 79ft. These heights are measured from surface of ground, and do not include foundations. Borings in the beds of the Danta and Nicholson sank through 30ft. of soft mud to clay. There are at least four of these dams that will have a height considerably over 100ft.

The members of the Walker Commission, in spite of the optimistic tone of their "preliminary" report, were evidently far from satisfied with these details of the existing project—they had, in fact, already ordered new surveys with a view to reducing the height of the embankments and of the Ochoa dam. Respecting the works required to this end, the following quotations from Admiral's evidence before the Senate Committee may prove of interest:—

One of the schemes is to put in a dam at Machuca. That would be the one to hold the lake up. Put in a dam there and drop down 25ft. or 30ft., and then have another dam at Ochoa or Tambour Grande, or wherever desired. . . . I think if we go across the divide the route of Menocal would be the one to follow, unless we come down—not building a dam at Ochoa at all—somewhere, say, to Tambour Grande, and build a dam there, avoiding the San Francisco, having the same cut across the divide—probably a little heavier—but avoiding the San Francisco embankments. . . . We have had some parties out to try how far we would have to run embankments, and it is quite possible they may be as bad as the San Francisco embankments. I think the chances are, by putting in a dam at Machuca and a dam below, at Ochoa or Tambour Grande, and taking a low level route, we may escape this heavy work, and get into Greytown with considerably less expenditure of money, and with a canal that would not perhaps keep its superintendent awake nights so much.

There are many other points to which reference might fitly be made to show how chaotic was the condition of the Nicaragua project, prior to the publication of the latest report. It is therefore not surprising, though none the less significant on that account, that very shortly after the Walker Commission avowed its predisposition towards the Nicaragua route, Congress rejected every measure before the Houses providing for such a canal, and passed a Bill for "a complete and full investigation" of the entire question

of any and all practicable routes across the isthmus, and particularly the two routes known respectively as the Nicaragua route and the Panama route, with a view to determine the most practicable and feasible route for such canal, together with the proximate and probable cost of constructing a canal at each of two or more of said routes. . . . For the purpose of defraying the expenses necessary to be incurred in making the investigations, there is hereby appropriated the sum of 1,000,000 dols., or so much thereof as may be necessary, to be disbursed by order of the President.

The directors of the New Panama Company, remembering the purposes for which the latter was established, and their fiduciary position in relation to the original shareholders, lost little time in responding to these virtual overtures. They frankly enough acknowledged that the company possesses neither mandate nor means to complete the enterprise, and that—having fulfilled its mission by preserving the property from decay and forfeiture, by establishing the feasibility of a trans-isthmian ship canal, and by submitting to the criticism of the world a well-digested project for construction—it now desired and was fully prepared to negotiate for a transfer of its rights. The company's exhibit at the Paris Exhibition was clearly intended as an intimation to this effect; indeed, there was not the slightest pretence to disguise the fact, for in a booklet, printed in English and freely distributed, the company expressed belief that the superiority of its canal would be confirmed by the American commission of inquiry, and that:—

If the company can succeed in effecting an equitable agreement, compatible with the rights and obligations of its Act of concession, between the interests with which it is charged and the interests desired by the American people in an inter-oceanic canal, every obstacle to definite measures for its completion will have disappeared. Until then the company can only act with reserve.

Unfortunately for the Panama enterprise — and, perhaps, for the realisation of a trans-isthmian canal available, on equal terms, to the commerce of all nations—M. Hutin and his co-directors have completely failed to appreciate the significance of the phrase, "interests desired by the American people." As the United States Commissioners very clearly indicate in their recently-issued report, the directors of the new Panama Company afforded to those delegates who visited Paris and the works on the isthmus ample facilities for a scientific investigation of the undertaking and of the project for its completion, which has been described in earlier articles. The result of this is seen in a virtual admission that, so far as technical considerations are concerned, the Panama project is quite the equal of, if not superior to, that recommended for adoption. Panama, however, is placed out of court by the fact that the Commission was appointed not only to determine "the most feasible and practical route," but also to state which canal could most readily be placed "under the control, management, and ownership of the United States." Touching these, to America all-important points, the Panama directors have neglected to submit to the Commission or Federal authorities anything like a definite proposition which would give to the United States an undisputed right of way and clear title to the property. Indeed, as now appears, it is more than doubtful whether any such absolute transfer could or ever can be negotiated. Thanks to the peculiar circumstances of its incorporation, the lien which the creditors and shareholders of the de Lesseps Company legally claim, that possessed by more recent creditors, and the generally-involved condition of its finances, the new company has found itself in the very unenviable position of being most anxious to sell, but so fettered as to be unable even to suggest a basis for negotiation. It is therefore not surprising that the latest American Canal Commission—"particularly in view of all the difficulties of obtaining the necessary rights, privileges, and franchises on the Panama route"—has followed the example of its immediate predecessor, and reported in favour of a rival scheme.

The Isthmian Canal Commission, appointed early in 1899, whose preliminary report was transmitted to Congress on the 4th inst., consists of nine members, including the president, Rear-Admiral Walker, and his two colleagues of the Commission of 1897. Pending the promised issue, "as soon as practicable," of a later and final report, containing maps, plans, and profiles, and other most desirable data, we refrain from offering more than superficial reference to the labours and conclusions of the Commission. It should, however, be at once frankly admitted that even the preliminary report affords proof that the Commission has loyally sought to carry out its instructions to investigate "any and all practicable routes." It organised and sent into the field no fewer than thirty-one working parties, of which twenty, with about 150 engineers and assistants, went into Nicaragua; five, with about twenty engineers and assistants, traversed the Panama route; and six, with about fifty engineers and assistants, examined in detail the Darien country. As a result, we may anticipate a more complete accumulation of data on this most interesting and important question than has ever before been collected.

Regarding the route recommended by the Commission, a few salient facts have been cabled to this country, but reference to the report itself is essential before these can be fairly estimated. The document admits that the Panama canal, after completion, would be shorter, have fewer locks and less curvature than that through Nicaragua, and that the time required for an average vessel to pass through each would be respectively twelve and thirty-three hours; but the Commissioners set off against these disadvantages and the greater cost of maintaining the longer canal the not very vital argument that Greytown is some 300 miles north of Colon, and therefore nearer the important cities of the Atlantic littoral. Their estimate of the cost of constructing a canal over the adopted route is as follows:—

	Dols.
Eastern division (from Greytown to Boca San Carlos dam)	82,662,000
Middle division (from Boca San Carlos dam to Las Lajas)	25,425,000
Western division (from Las Lajas to Brito)	51,680,000
	159,767,000
Ninety-eight miles of railroad	7,350,000
Engineering, police, sanitation, and general contingencies	33,423,000
	200,540,000

Apart from this estimate, much in excess of any earlier calculation of its kind—the greater depth and width proposed throughout the entire length of the canal, and the double system of locks strongly recommended by the Commission—the most conspicuous features of the new project in relation to former Nicaragua schemes are (1) an important modification of the route in the eastern division, dictated in the interest of the security of the canal, and, it may also be assumed, for the purpose of avoiding some of those dangerous "minor" structures already spoken of; and (2) the great dam across the San Juan River at Boca San Carlos, which is intended as a substitute for the dam heretofore projected at Ochoa, to hold back the waters of Lake Nicaragua and enable its level to be regulated. This structure, of which no technical details are yet given, is described by the Commission as "the most difficult engineering work in connection with the Nicaragua project," the building of which will be "a costly and tedious operation," requiring at least eight years' labour. "It is of great importance," states the Commission,

"that this dam should be located above the mouth of the San Carlos River, as the latter discharges at times as much as 100,0;00 cubic feet of water per second, carrying with it great quantities of sand. The Nicaragua Canal Commission made search for a dam site above the mouth of the San Carlos, in what is called he Agua Muerta—dead water. One was found at a place about two miles above the mouth of the San Carlos River. The maximum depth to hard rock is about 40ft. below sea level, or about 100ft. below low water in the river at the site, which will make it necessary to construct the foundation of this part of the dam by the pneumatic process. The dam in the deepest part will then have a height of about 150ft. As the pneumatic process is an expensive and slow one at best, this Commission has made search for an alternative site a few miles further up the river, where the topographical and surface indications seemed to offer favourable results. One has been found which gives promise of a more satisfactory and less expensive solution of this problem."

As regards an estimate for the completion of the canal, the Commission offers the following remarks, premising that the time required hinges almost entirely upon the uncertain progress of the Boca San Carlos dam. It is consequently very evident, despite the feverish activity of politicians at Washington, that the twentieth century will have attained a very respectable age ere any necessity can arise to cause worry about defending or blockading the projected waterway.

After a harbour has been opened at Greytown, and a railroad constructed, the way will be open to attack the work from a great many points at the same time, so that if ample funds are then available the excavation of the prism of the canal ought to be completed in a comparatively short time if prosecuted with vigour. At least two years will be consumed in preparatory work and in opening a harbour at Greytown, so that if work on the dam should be commenced immediately thereafter, the time required for completing the entire work would be about ten years.

Before bringing these articles to an end, brief mention should be made of other canal schemes which were formerly much thought of, and yet command a considerable amount of support. In each case the route proposed is south of Panama, across that portion of the isthmus known as Darien. One project dates back to the days of William Paterson, the founder of the Bank of England, and was again brought into prominence in this country by the support given to it, between the years 1850 and 1870, by the then Sir Thomas Brassey, Lord Wharncliffe,

Sir Charles Fox, and Mr. Lionel Gisborne. Since then the Atrato route has been frequently explored, and is now chiefly associated with the name of Commander T. O. Selfridge, U.S.N., who in 1870-1, conducted an expedition across the isthmus. The Selfridge project is that the contemplated canal should follow the river Atrato from its mouth in the Bay of Atrato for 149 miles, and then traverse the remainder of the isthmus along the valley of the river Napipi, a distance of 31 miles; and it is claimed that the latter is the only portion which would require to be constructed. The water level of the canal from the point of departure from the Atrato would be 30ft. above the mean level of the oceans, and it is proposed that the descent should be accomplished by two locks near the outlet, and a tide-lock quite close to the Pacific. The canal would be fed by the rivers Atrato and Napipi, and a tunnel 5¼ miles long would require to be cut for its passage through the mountain ridge. A route advocated by Mr. Thomas W. Hurst, an Englishman long resident in the United States, starts from the Atlantic side at Caledonia Bay, joins the Savanah River, and follows that stream to the Gulf of San Miguel, on the Pacific side—a total distance, it is stated, of thirty-three miles. Yet another route across Darien was that championed, about the year 1864, by an enterprising American named Kelley, who argued that a canal, thirty miles in length, might be readily constructed from the Bay of San Blas by utilising the Bayano River. He contemplated no locks, but included in the scheme a tunnel of seven miles. Both the Atrato and San Blas projects were considered at the International Congress held at Paris in 1879. This gathering, it is of interest to remember, condemned the Nicaragua route on account of its great length, the number of locks contemplated, and because its region is subject to earthquakes. The Selfridge project was severely criticised because of its length, the serious obstacle to safe navigation threatened by the floods of the river Atrato, the doubt whether sufficient depth could be obtained at the river mouth without great expense, and the undisputed facts that the suggested canal would traverse the most rainy portion of the isthmus and a region lacking in all material except wood; while serious exception was taken to the San Blas scheme, because of its proposed tunnel and the absence of any site for a harbour on the Pacific side.

HOLDERS AT THE BIRMINGHAM GASWORKS.

No. III.

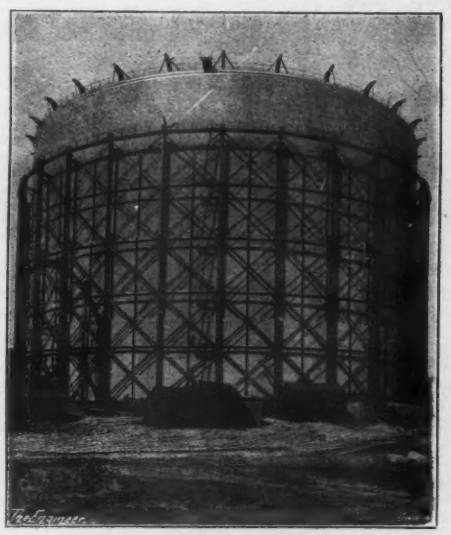
A PUMPING sump was provided for the use of the contractors for the tank, who were required to construct a closely-timbered cross trench from the tank excavation to the sump, and to use the sump to keep the excavation work free from water during its progress. A drain was carried round the foot of the cone of the tank to convey springs found during the excavation to a cesspit opposite the cross trench. Pumping machinery in duplicate was provided to guard against breakdowns, and the pumped water was conveyed to the small river Rea, which runs through the Nechells works. This method of keeping the water down proved most satisfactory, and the sandy ballast was brought to the surface during the excavation merely in a slightly moist state. It was easily dealt with in this condition, whereas it would have given endless trouble had not this deep pumping well been used throughout the work.

The excavation was commenced by a trench, of which the inside diameter at bottom was required to be not more than 255ft., and the outside diameter about 280ft., to include the thickness of the main piers; the trench being close-timbered on both inside and outside throughout. One portion of the trench was carried down to a maximum depth of 48ft. below the coping of No. 5 tank, for the inlet and outlet pipes. The different timbers were struck and the back planks drawn up as the walls were built, after the brickwork had set well and had been backed up. The cavities occasioned by the drawing of the timbers, and the spaces between the walls and the back of the excavation, were filled up with sand well watered and rammed. Other struts were fixed from the planks placed against the walls to the inner circle of timbering to keep up the latter after the main timbers had been struck. On one side the original surface of the ground was higher than the new coping, and here it was excavated to the level of the coping for a width of 20ft., and, similarly, where the original surface was lower than the new coping, a 20ft.-wide embankment of selected material, carefully punned, was formed. An annulus of cement concrete, 10ft. 8in. wide by 2ft. thick, was formed as a foundation for the tank wall, which between the piers was six bricks thick for a height of 19ft. 6in. from the bottom, reducing by half a brick for the next and and every succeeding 4ft. in height, finishing at top with three bricks thick. Thirty equidistant main piers eight bricks thick by nine bricks long throughout, and thirty intermediate piers seven bricks thick by six bricks long, reducing from a height of 4ft. 6in. below the top, in equal set-offs of 2¼in., to three bricks at the top, were constructed in the wall. Five bands of brickwork, eight courses deep, as shown in the sectional drawing on page 629, were built in cement mortar throughout the wall, including the piers, the remaining courses being in lime mortar. On the upper and lower sides of the five bands layers of hoop-iron bond were built, 1½in. by $\frac{1}{16}$in. thick, one strip in every layer to each half brick thickness of the wall. The ends of the strips overlapped 6in., and were double riveted, while radial straps 10ft. apart attached the rows of strips together; one rivet being used at each intersection. The hoop iron was tarred and left to dry before use.

After the walls of the tank had been built to the ground line, the ground within was excavated to the depths, slope, &c., shown in the sectional drawing on page 629. The bottom of the tank for a distance of 8ft. from the face of the tank wall was paved on top of lime concrete in brickwork, one course on edge, set in cement mortar. The slopes and top of the cone were lined with lias lime concrete, the thickness at the foot of the cone being 22½in., reducing to 12in. at the top edge of the slope, and continuing 12in. over the top of the cone. A slope of 2 to 1 was adopted. One culvert and one invert were formed of four and three half-brick rings respectively through the tank wall, for the passage of the inlet and outlet pipes, which were 36in. in diameter.

The crown of the gasholder was, as is the case with other large holders, untrussed, and, therefore, framing had to be provided in the tank to sustain the crown when the holder was lowered. For the support of this framing there were provided eighty-four piers rising from the bottom of the tank and cone, in addition to a hollow brick pier in the centre. The positions of these piers are shown in the plan of the tank on page 629. The centre pier was 10ft. square at the top, and 16ft. square at the bottom, with seven courses of footings on a concrete foundation 20ft. square by 8ft. deep. The walls of the pier were two and a-half bricks thick, with an arch in three rings 4½in. thick 5ft. from the top. It was built in brickwork solid above the arch to the top, which was finished off with stone on the outer edge 1ft. thick, leaving a centre filled with brickwork 6ft. 6in. in diameter. The eighty-four brick piers were four bricks each way, on four courses of footings, resting on concrete 24in. thick. The piers were 6ft. and 7ft. in height.

A stone 6ft. 3½in. by 5ft. 6in. by 1ft. 6in. thick, was bedded in cement on top of each of the thirty main piers in the tank wall for the foundations of the columns of the guide framing. Between the stones the wall was finished by a coping of best blue bricks 2ft. by 6in. by 6in., set in cement after the gasholder was finished. Around the annular bottom of the tank, and butting up against the wall, sixty landing stones, 6ft. 3in. long by 2ft. 6in. wide by 17½in. deep, dressed level and true on top, and axed square on the sides, bottom, and ends, were fixed perfectly level one with the other, and well set in a bed



SALTLEY GAS HOLDER

of cement mortar. These landing or rest stones support the lifts of the holder when down. On the thirty intermediate piers in the tank wall were fixed stones, 2ft. by 1ft. 6in. by 1ft. 6in., with the front projecting from the brickwork for the tank guides. The fronts were plumbed and dressed off when the guides were fixed. Holes were drilled in the stone of the centre pier, and of these stones, for twelve and four Lewis bolts respectively, and four holes 3½in. square, were drilled in the base stones on the main piers for the holding-down bolts of the columns. The upper surface of the holding-down plates was 14ft. 5in. below the top of the base stones on these piers. The holding-down plates are 6ft. by 5ft. 7in., of 1½in. metal throughout, with four bosses, 6½in. deep, recessed for the heads of the holding-down bolts to rest in. These bolts are 2½in. in diameter, with 6in. T-shaped heads, and 8in. diameter screw ends. Vertical holes, 5in. square, were left in the brickwork of the piers for the holding-down bolts.

For the support of the timber framing, 84 cast iron columns, in three or four lengths, secured at their lower ends to the brickwork piers in the tank by four bolts, 3ft. 2½in. long, ¾in. diameter, and a holding-down plate 1ft. 10in. square, formed of 4in. by $\frac{5}{16}$in. flats. The columns varied in height according to their position in the tank. The first or inner circle comprises fourteen columns, top length 9ft. 9in., middle and lower lengths 9ft. high. The second circle, from the centre, also comprises fourteen columns, top length 6ft. 1⅝in., middle and lower lengths 9ft. high. The third circle, from the centre, comprises twenty-eight columns, top length 11ft. ⅝in., middle and lower lengths 9ft. high. The outer, or fourth circle, comprises twenty-eight columns in four lengths, the upper 9ft. 3⅝in., the remaining three 9ft. high. The lower lengths throughout are 10in. diameter at bottom, tapering to 8in.; the remaining lengths are 8in. diameter throughout. All are of ⅝in. metal. The lengths were provided with suitable brackets for bolting them one to the other, or to the holding-down plates, and with lugs at suitable angles for the tie rods, shown in the sectional drawing of the tank on page 629. These tie rods are of ⅝in. diameter, wrought iron, in two lengths, with right and left threads, screwing into a hexagonal coupling screw. There were 238 tie rods in all.

The framing, fixed as shown in the plan of the tank on page 629, is of best pitch pine, thoroughly seasoned, and free from imperfections. It is 245ft. in diameter, formed to a true segment of a sphere, diameter 252ft. 9in., and rise 22ft. It consists of a network of half-timbers, sawn square from a 13in. baulk, so as to be not less than 12in. by 6⅝in. net. The timbers forming the radials are made continuous by three scarfs, 2ft. 6in. long, with wedge and two ¾in. bolts. The cross pieces and short radial timbers were of the same section. They rest on and are securely bolted to shoes, as shown in detail at A and B, page 629. The shoes at the tops of columns and the centre shoe are also shown in detail on the same page. A cast iron plate, about 4ft. 6in. square by 1¼in. thick, was provided to cover the drain pit in the tank.

The tank was made water-tight by an inside rendering of a ¼in. coating of one part of the best Portland cement to one part of washed sand, finished off with the addition of a ¼in. coating of neat Portland cement, all applied while in a freshly mixed state. The rendering was continued underneath all piers, resting blocks and paving, and care was taken thus to form a continuous and solid coating, impervious to water. The cement used was required to be ground so that not less than 90 per cent. passed through a sieve of 2500 meshes per square inch, and to be capable of bearing a tensile strain of 500 lb. per square inch at the end of seven days' immersion in water.

The bricks used in the brickwork of the tank were good, hard Staffordshire full-sized bricks. The lime mortar was composed of one part best Warwickshire hydraulic lump lime and two parts clean and sharp washed sand or grit, free from loam or earthy matter, mixed in a steam mortar mill freshly as required for each day's consumption. The lime concrete was composed of five parts clean sharp ballast or broken stone, one part of clean sharp washed sand, and one part best ground blue lias lime. The cement concrete was composed of six parts ballast or broken stone, one part clean sharp sand, and one part best Portland cement, weighing at least 112 lb. per bushel. The ballast or broken stone was required to pass through a 2in. ring. The cement mortar was one part washed sand and one part best Portland cement. The stone for stonework was from approved quarries, of hard, close-grained quality, and free from defects. Three hundred well-seasoned English oak blocks. 18in. wide by 13in. thick by 18in. long, were built in the tank wall at the piers, projecting 2½in., for fixing the tank guides. After these had been fixed to the blocks, the front face of the blocks was sawn off as nearly as possible flush with the wall after rendering. The tank was filled with water after the gasholder had been completed, care being taken to let the water rise gradually in the well at the same time, but a little in the rear of that in the tank. Air-holes were left at the top of the slope of the cone until the water had risen up to the underside of the concrete on the top of the cone, when they were made good with concrete in cement.

The illustrations given in our issue of December 7th, page 563, show (1) the gasholder tank with the framing for supporting the crown of the holder in course of construction; and (2) external view of the completed tank with framing. The illustration on page 630 gives an internal view of the tank, showing the framing when completed. The contractors for the tank and the erection of the framing were John Aird and Sons, while the ironwork for the tank was supplied by Thomas Piggott and Co., Limited. Mr. Hack speaks very highly of the manner in which the contracts were fulfilled, especially the difficult work of excavating and timbering the trench for the walls of the tank. The section, plan and detail drawings on page 629 are copies of those to which the contractors worked, but thirty main piers were constructed round the tank instead of twenty-eight as shown in the plan.

All the steel used in the work was required to be of a mild description, capable of sustaining a tensile strain of not less than 28 tons nor more than 32 tons per square inch with not less than 20 per cent. elongation taken in a length of 10in., with the exception of the rivets for which the limits were 27 and 30 tons, with not less than 25 per cent. elongation. No chipping or rimering of bolts or rivet holes was allowed. The heads (hexagonal) of all bolts were required to be forged in one with the bolts, their thickness equal to the diameter of the bolt, and their width at the narrowest part to one and three-quarter times the diameter. The ends of plates and bars where they butted, with certain specified exceptions, were required to be cold sawn or fitted square, so as to make a perfectly true and close joint. Sheets and plates were required to be smooth on the surface, and free from shakes, blemishes, and all defects. The rivets and joint plates were such as to maintain the full strength of the bars or plates through the joint. The rivets for the thin sheets were required to be $\frac{5}{16}$in. in diameter, 1½in. pitch, riveted cold with a string of tape soaked in red lead inserted between the sheets. All other riveting in proportion to the thickness of the sheets riveted hot. The whole of the cast steel was required to be of approved quality easily cut or drilled, free from cinder, honeycombs, flaws, cracks, and other defects, and all castings perfectly clean, true, and out of winding.

The contractors for the gasholder were required to raise it when completed by means of air, and to test the work for soundness and proper adjustment. The holder when filled with air was kept up for forty-eight hours to test its soundness, and then after being slowly lowered was again raised for re-examination. The holder actually started work early in November last year, and has behaved extremely well in all weathers since that time. The pressures thrown by the holder are as follows:—

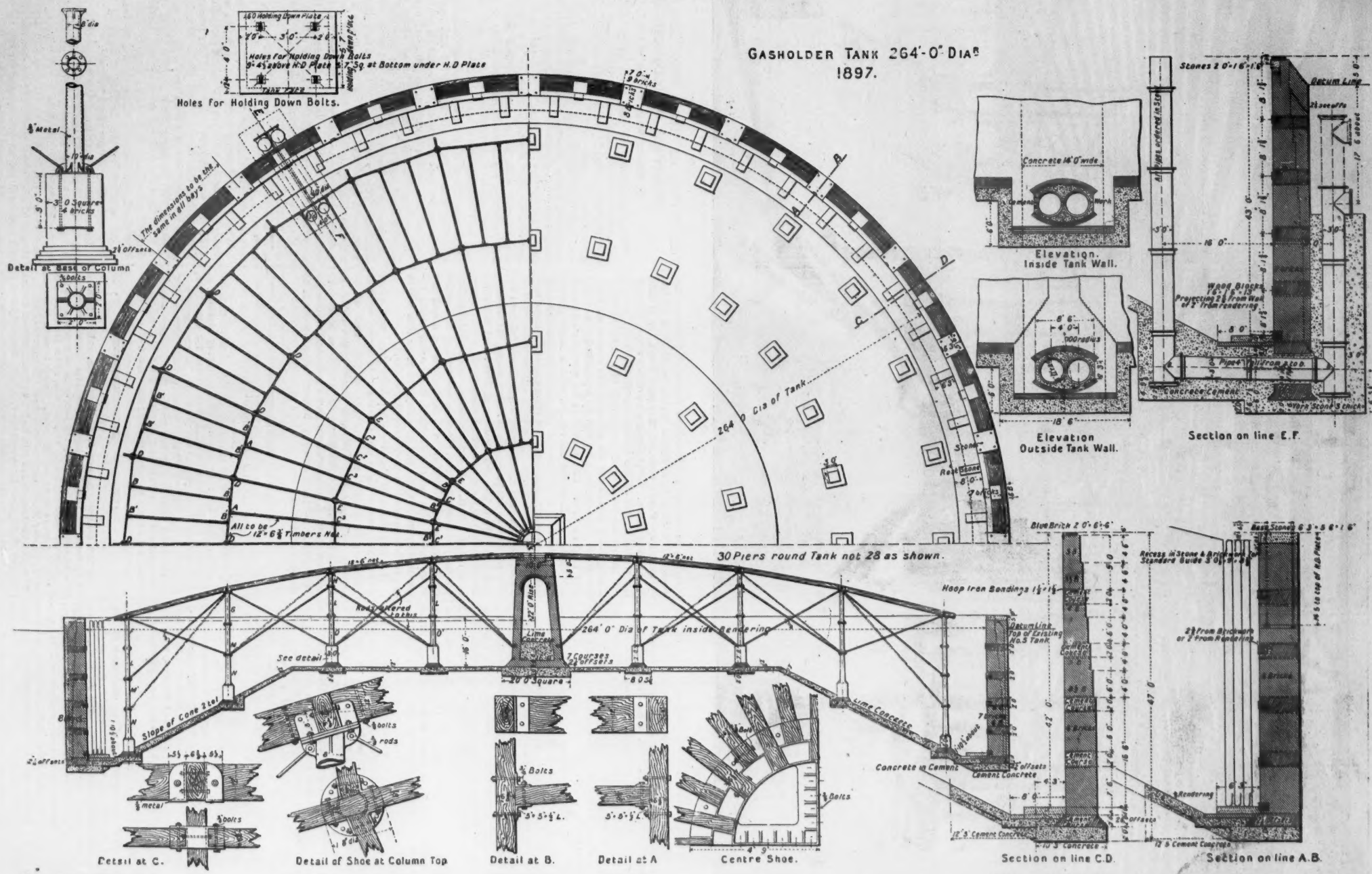
No. 1 lift, including water in cups,	=	4·4in.	of water
,, 2	,,	,,	,,	=	6·0in.	,,
,, 3	,,	,,	,,	=	8·0in.	,,
,, 4	,,	,,	,,	=	10·49in.	,,

Calculated from these pressures, the floating weight of the material, after deducting the weight of water in the cups, is for No. 1 lift, 514 tons; No. 2 lift, 178 tons;

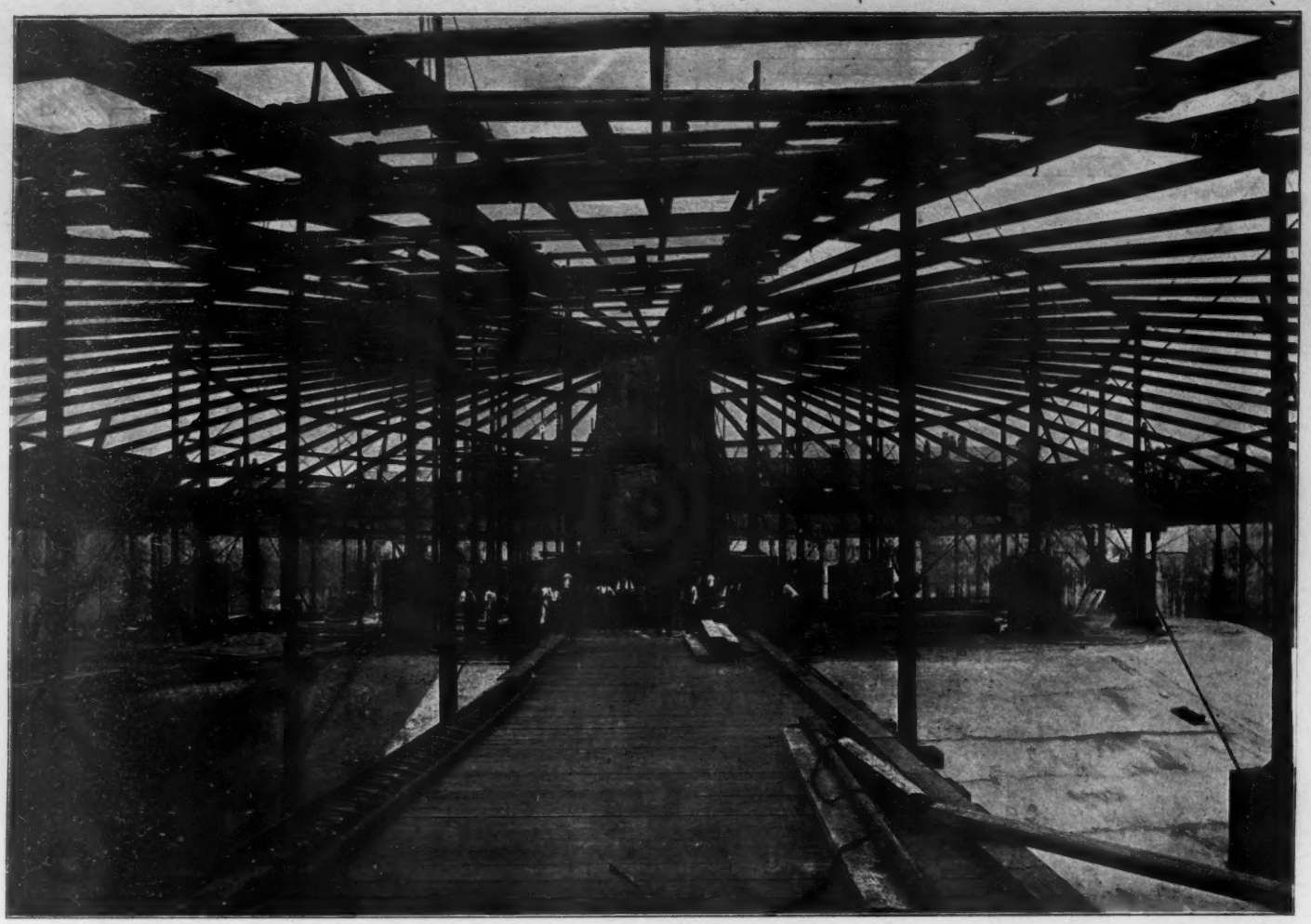
SALTLEY GAS HOLDER—TANK AND FRAME

MR. HENRY HACK, M. INST. C.E., ENGINEER

(*For description see page 628*)



SALTLEY GAS HOLDER—INTERNAL VIEW OF TANK AND FRAMING



No. 3 lift, 232 tons; and No. 4 lift, 307 tons. The weight of the steel in the guide framing is practically 933 tons. The cost of the tank, including the framing and iron-work, was approximately £30,000, while the contract for the gasholder and guide framing amounted to about £38,000. Sundry work done by the gas department of the Corporation brought up the total cost of the new gasholder to about £72,000. These figures indicate what a large portion of the total cost of a gasholder is formed by the cost of the tank, especially on bad ground, and hence the economy of increasing the number of lifts becomes very evident. The cost of the new No. 6 holder per million cubic feet stored is about £9000, whereas that of the extension of No. 5 gasholder, where the tank was already in existence, worked out at a rather lower figure.

The contractors for the No. 6 gasholder and framing were C. and W. Walker, of Donnington, who were likewise the contractors for the gasholder of nearly equal capacity at the Beckton works of the Gas Light and Coke Company. A view of the completed holder is given on page 628, and a cursory glance at this alone will indicate some important differences between the framing of this and other large holders. Among these may be mentioned the absence in the Saltley holder of lattice work in the standards and girders. Though some saving in the weight of material used might have been effected by the substitution of lattice standards, the initial cost would have been increased, and the cost of maintenance—painting, &c.—would have been considerably greater. The pile steel girders are a valuable innovation in gasholder construction. The ties are simple and effective. The framing of the holder is, indeed, a model of simplicity of construction, combined with great strength, and it certainly takes front rank among existing large gasholder framings in this respect. The design of the holder, including tank and framing, reflects the greatest credit on Mr. Hack, who was solely responsible for it.

In the preparation of the drawings for these works Mr. Hack wishes us to state that he was greatly assisted by his then head draughtsman, Mr. C. Richmond, who has since been appointed superintendent of the new works of the Corporation at Nechells, where the new gasholder is erected.

The Saltley and Nechells works of the Birmingham Corporation now display many other evidences of Mr. Hack's great ability as a constructing gas engineer. There is a new retort-house, 324ft. long by 114ft. wide, which will be ready for the production of 5,000,000 cubic feet of coal gas per diem in a few week's time, and later a similar house for an equal volume will be completed. Inclined retorts have been adopted here, as elsewhere on the works, and the manipulation of the coal and coke from the time the former is tipped into the coal breakers to the time when the latter is loaded into the trucks of purchasers, is effected entirely by mechanical means. The charging stage of the retort-house is specially designed to mitigate the intensity of the heat which is so seriously felt wherever inclined retorts are used. The stage is of ample width, with large central openings, up which cool air may pass from the ground floor of the house. Over the centre of the stage, through the whole length of the house, the semicircular roof is left uncovered for a width of about 6ft., thus affording unsurpassed means for the egress of the heated air from the stage. The stoker's lot will be a pleasant one in this new retort-house. The coke will be quenched and removed by de Brouwer conveyors, which have proved highly satisfactory in some of the more progressive continental gasworks, but have not hitherto been extensively adopted in this country. The coke will be discharged by the conveyors into a pit, from which it will fall into the skip of a crane made by Sir W. Armstrong, Whitworth, and Co., having the great radius of 75ft., and therefore commanding a large extent of coke yard, truck sidings, and canal wharf. A similar crane, made for another part of the Saltley works, where it has worked very satisfactorily, was illustrated in The Engineer about six years ago. The new coke yard is in reality land reclaimed by walling in, and covering the river Rea where it passes through this portion of the works.

It is impossible to describe adequately these and other new buildings and plant just erected or in course of construction at Saltley and Nechells at the close of an already long article. The new retort-house alone is worthy of detailed description, as it will be second to none in point of completeness and excellence of design. We must, however, reserve further remarks on it to another occasion.

LORD ARMSTRONG.

We regret to have to announce, at the moment of going to press, that Lord Armstrong died yesterday morning at Cragside. He had been in indifferent health for some time, and sank rapidly during the last few days. He was nearly contemporaneous with the century, having been born in 1810, and in many respects was one of the most notable men of the nineteenth century. An account of his life and of the work he did must be reserved to a future issue.

A new concrete dam at Chaudiere Falls, in the province of Quebec, has been built for the Canadian Electric Company. Within forty-eight hours after the last batch of concrete was put in place the water was flowing over the dam, and a few hours later there was 4ft. of water on the crest. Owing to severe rains the river rose over 8ft. in less than three days. This dam is 824ft. long, 20ft. wide on the base, and 18ft. high; the face is built on a curve, and provision is made for raising the water 2ft. more by means of flash boards. The dam is built entirely of concrete masonry. In ordinary stages the water is allowed to discharge through bye washes pending the completion of the power-house and the setting of the turbines, but on November 23rd, during the flood referred to, the water was 4ft. 8in. over the crest.

THE CAUSES OF RAPID WEAR AND TEAR OF FIRE-BOXES OF LOCOMOTIVES.

By Robert Weatherburn, M.I.M.E.

There is nothing in the whole range of locomotive maintenance which causes more annoyance and trouble than fire-boxes of main line express engines. Their rapid depreciation, in spite of the care given in selecting the best copper obtainable, and working it in such a manner as to avoid those objectionable forms which conduce to local fracture, has been a bitter disappointment felt by every locomotive engineer. Comparisons instituted between the short life-time of copper in modern fire-boxes as compared with those manufactured thirty to thirty-five years ago, led to the belief that either of two things was the cause, or more probably both, *i.e.*, that it was due to the extra work now being done, or that the copper was not of so good a quality as formerly. Thirty years ago plates were stipulated for and made $\frac{7}{16}$in. in thickness for back and side plates, crown plates $\frac{7}{16}$in. or $\frac{1}{2}$in., and tube plates from $\frac{1}{2}$in. to $\frac{13}{16}$in. and even 1in.

There have always been different kinds of copper, ranging from soft to hard, but the required degree of hardness or softness has never yet been satisfactorily defined. This is as much due to the fact that engineers are not yet decided which of the two coppers is the worse, whether the too soft and yielding, which soon becomes distorted and wears quickly; or the hard and resistant, which is more liable to flaws or fracture. However, it may be taken for granted that this is mostly a question of shape of box and position of plate, and a study of the side plates, whether straight or curved under heat, to ascertain the point of greatest hinge action, should in itself be a guide. Copper manufacturers may therefore be excused when the users are in this dilemma.

Whatever difference there was, or is, in working the plates into the proper form after their reception from the makers, is undoubtedly in favour of the present system. For instance, the flanging into shape of tube and back plates formerly required from two to three, or even more heatings, with no other guide for the right temperature of plate than the dull red glow, or the further test, the firing of a dry hazel stick drawn quickly over the plate. Now the flanging can be done at one operation, or two at the most, so that the liability of injuring the copper by over-heating is very much reduced.

In present-time fire-boxes the deterioration most to be apprehended is the fracturing or flawing at some portion or other of the tube plates, and this has naturally caused most engineers to requisition a soft copper, which shall be able to resist in the way of give and take the many strains to which that portion of fire-box is liable, but such soft copper is not at all suitable for the sides and back plates, as the wear by firing, aided by the action of the deleterious gases, soon reduces such plates below the safe margin required for modern pressures, so that incidentally it may be here stated that the provision for

side and back plates of somewhat harder material than that used for tube-plates, would appear to be the right thing. Now if the fire-boxes of the present date differ but little, and that only in matters of small detail from those of forty years ago, it should not be a difficult question to find at least how the mischief originates, even if no successful remedy immediately follows. We must at least credit locomotive engineers with being able to obtain good copper which shall stand the required tests, with the necessary ductility. Further, the variety of copper manufactured in home and foreign markets, by different processes, should provide at least such examples of metals as to give conclusive proof whether the material is alone at fault. It will be remembered that Mr. Tomlinson, one of the late presidents of the Institution of Mechanical Engineers, instanced the fact—which was largely in support of the theory of good and bad copper—that some of the Metropolitan engines were still running with the original fire-boxes supplied by the makers. Such instances are not by any means scarce, as many of the fire-boxes of engines built in Manchester for the Swedish Railways many years ago were still in comparatively good condition after from twenty to twenty-five years' service. Such analogies, however, are of comparatively little value; for although the total mileage in each case, as compared with English main-line passenger engines, might be equally good, still the time of running them is the true gauge of effects. Metropolitan engines rarely exceed a speed of 25 miles an hour, and 25 to 30 miles per hour is the outside speed of the Swedish engines, whereas a speed from 48 to 60 miles per hour and more, maintained from 200 to 250 miles—double journey—is daily run over the first-class main lines of this country. Thus it readily suggests itself that the more rapid depreciation in this country is the result of harder work and higher temperatures, consequent on greater speeds and heavy loads; but an examination even of that does not satisfactorily account for the disproportionately rapid rate of depreciation, so that an examination further afield is necessary.

By virtue of the fact of comparatively small fire-boxes and hard firing, high temperatures are attained far exceeding what would be required by a larger box; or, to put it otherwise, the temperature is in inverse proportion to the size of fire-boxes, and the heat necessary to evaporation is passed through plates of too small an area.

The excessively high temperature to be found in fire-boxes now-a-days would not be nearly so harmful, providing that it was more generally distributed over the tube plate, but the vagrant nature of draught in locomotive engines, due to certain inherent structural defects, subject some tubes at the middle of the tube plate to double and even treble the heat of those situated at the sides and bottom, and the tube plate must on the fireside be proportionally affected, thus causing local distortion or lengthening by extra expansion, which may not show its effects for some time, but which at length too surely undermines stability and, along with other stresses, develops flaws.

Before proceeding further it may be as well to explain the meaning of "vagrant draught" as used in its relation to the locomotive. A general and equal diffusion of heat through the tubes would be a proof that each was equally in draught operation, but as a proof that such is not the case we may here instance that, as a rule, the heat in most of the side and bottom tubes in engines working hard is not sufficient to melt lead which flows at 610 deg., whilst in other tubes in the middle and near to the top, copper and brass test pieces have been melted, whose flux point stands respectively at 1950 and 1834 deg., or about three times as much.

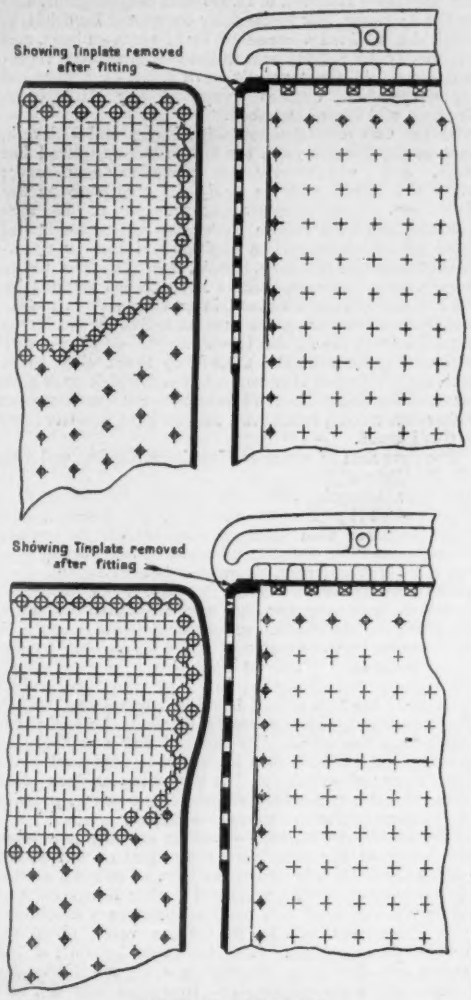
Localised, or unequal draught, might be the better term, but draught becomes vagrant, or shifting, through irregular and bad firing, and is more particularly attributable to defective-blast pipe arrangement, very largely aggravated, as will be later shown, by restricted calorimeter, caused by the use of small tubes.

There has until late years been a singular misapprehension of the proper position of the blast pipe. So long as the vent or orifice was a little above or level with the top row of tubes, and its diameter equal to about one-quarter of that of the cylinder, no further thought was given. If a sufficiency of steam was obtained it was considered satisfactory, if not, the vent was closed somewhat until such was the case. The vacuum in the smoke-box varied from 6in. to 8in. of water, and in too many instances the larger figure was accepted as an evidence of efficiency. Moreover, such vacuum measurements by water were invariably taken midway of the smoke-box, in the belief that the effect was the same both top and bottom. Now, as a fact, the region of the greatest vacuity in smoke-boxes is represented by the vortex of every ordinary blast pipe, whether above or below the top row of tubes, so that taking a radius from the centre of a vortex to the other side tubes and describing a circle will show the fallacy of high or moderately-high blast pipes, for those tubes most remote or without the radius, or, in other words, those tubes which stand the nearest inside or outside to the radius line, are the least affected. Applying this system to the diagram of the tube plate, it will at once be seen that the tubes which will be most affected are those nearest to the vortex, hence the difference in the heat currents of side and bottom tubes from those in the middle and the top. It is also self-evident that, as the vortex is the inductive medium, that the air current or products of combustion will rush to that as a centre. So far, although only touching the fringe of the subject, it will be necessary to turn to the question of quantity and diameter of tubes, the smaller the tubes the greater the effort required to break up the products of combustion after leaving the fire, *i.e.*, to separate or apportion them to each tube. During long quick runs a dynamic effort, whose magnitude cannot be properly appraised, is required for that purpose, and to obtain this a powerful and inimical gas friction is set up on the fire side of the tube plate, which really intensifies or adds to the heat of the gases or lambent flames which beat upon the crenellation before separation is effected.

The late Mr. Stirling, otherwise a successful designer, made the grave error of using tubes of very small diameter. The otherwise admirable single-wheeled express engines were originally fitted with 217 tubes of $1\frac{9}{16}$in. outside diameter, representing a total flue area of two square feet. In after years he used 174 tubes, $1\frac{3}{4}$in. outside diameter, with an area of 2·28 square feet, and obtained much better results. This was due to the increased calorimeter obtained from a smaller number of larger diameter tubes. The same mistake to even a greater extent was made by Mr. Stroudley, and, as in the former instance, only partially atoned for by putting in tubes of somewhat larger diameter in engines of a later design.

It may be here stated that a sure and healthy sign is manifest by the gradual but sure return to the use of $1\frac{3}{4}$in. and 2in. tubes, both in America and this country. To return, it will thus be seen that the burden of excessive heat, passed through too limited an area of plates, intensified by the additional heat caused by gas friction on the tube plate, causes a lengthening of the fireside surface, further aggravated by the energy of a vast mass of brass or copper tubes expanding nearly wholly in one direction, with the copper tube plate suffering through two-thirds of its thickness by loss of cohesion amounting to nearly one-third. All this quickly finds out any weak and defective features, either at corners, bends, or tube holes.

Again, the excessive high local temperatures, with their



FLAWS IN FIRE-BOXES

consequent falls when steam is shut off, cause the tubes and plate to be more active in expansion and contraction, and tube-leaking ensues, which compels the use of that powerful, yet disruptive weapon, even in skilled hands—the tube expander—which at every operation slowly but surely distends the plate and makes it too big for its environment of flanges. Now, should the first vertical row of side stays be pitched too close to the flanges they will resist the enlargement of the tube plate through the expansion effort, caused by heat and tube expanding, and will be under compression. Indeed, so severe is the strain imposed on the outer shell in this locality, *i.e.*, close to saddle plate, by this reversal of pressure, that it too frequently causes the latter to flaw, or at all events to distend the surface, so as to allow of rapid pitting by admitting the acids, natural and imported, to attack the distended surface. Should the said stays be pitched well clear of the tube plate flanges, then the enlarging process can go on, and the distortion will be confined to the junction of tube plate with the side plates, and is not nearly so rapid in its destructive action.

The flaws at the sides of the tube plate which determinate into cracks are caused by this action; indeed, it is not saying too much that nearly all those insidious influences which tend either in one place or another to crack the tube plate, either at bottom, sides, or top, are distinctly traceable to the pardonable desire to impart rigidity of construction. Before proceeding further, it should be stated that one of the most fertile causes of tube plate fracture has been the practice of building too small diameter boilers, thus limiting the area of smoke-box tube plate until it becomes almost inflexible, throwing the onus of tube expansion in length and deflection on one tube plate only, and that, by virtue of the weaker material, the least able to resist. If it were possible to impart an equal amount of flexibility to both tube plates, the result—a reduction in flaws—would be realised.

As a rule the copper tube plate is pierced for tubes so close to its flanges at sides and top that no flexible margin is left, and the whole of the movement or hinging is confined to the outer interstitial tube divisions there intensified and backed by the rigidity of flanges still further stiffened by the plates to which they are riveted.

The position of rupture, or cracking of copper plates, is often the reflex action of the system of stiffening the smoke-box tube plate, materially assisted by the want of flexible margin in the copper plate as mentioned.

Copper tube plates according to the system of tube pitching, vertical or oblique, with the already-mentioned difficulties, crack variously, *i.e.*, either along the bottom, sides, or top rows. Cracking at the sides, as already instanced, is due to the enlargement of the tube plate by heat and mechanical action—expander—and want of marginal flexibility caused by too close pitching of the first vertical rows of side stays. The cracking from hole to hole at the bottom is due to a combination of causes, the principal of which are too rigid palmstays with badly-pitched supporters, and tubes being too close to the bottom of boiler.

The cracking from hole to hole at the top row of tubes is due more particularly to the lengthening of the box, not vertically but in the horizontal line, *i.e.*, expanding from the base of the copper stays at the footplate end, which unite the outer shell at the front plate, and which expansion, in a 6ft. box, would be one-sixth of an inch, and this action has to contend against the tubes pushing in an opposite direction from the base of a too rigid smoke-box tube plate, and these opposing forces acting on the top row of tube holes, with a rigid curve above the crown plate, form the position of the hinge action either between the said tubes or just beyond the lap of the tube plate flange. Such action is not always accompanied by visible distortion, for where, as in the curved corner, where the feet of the girder stays rest, the material is held so fast, and the ridge of the seam forms so short a fulcrum, that at times the copper will break almost as clean as a knife cuts, close up to the seam in the crown plate.

Although the tube plate is more particularly the failing point, it by no means follows that it is the only portion which gives trouble.

It often occurs that fire-boxes give trouble on the crown plate, the causes of which are as simple as numerous, for with girder stays closely fitted on the front and back seams and curves, the copper cannot expand in the proportion of three to two, against the combined resistance of such a congery of cast steel or solid forged girders bolted thereto every four inches, so that the result of this conflict is that occasional leaking occurs at bolts. Sometimes cracks form, due to the combined agency of restricted expansion and dirt, or too broad a surface of metal touch, which prevents water contact.

In order to obviate the binding influence of girder stays at the two ends, the writer would advise that they be fitted on to the curves of front and back plate with the interposition of strips of thick tin, laid lengthwise, along the bend, as shown in the accompanying sketch. After all the stays have been fitted, and previous to bolting them permanently to the crown, the tin-plate should be removed. This would partly free the crown plate from compressions which tend to distortion and leakage.

Very occasionally those fire-boxes, which are widened out at sides above the level of frames, will develop flaws at the radii of bends; which invariably, in such cases, run from stay to stay.

Their first delineation is about midway in the width of the plates, and is the result of pressure and obstinate staying, acting on the most flexible and hottest portion of the plates, and opposing their upward expansion, the radii being often too small and the bending of the plates not evenly performed, thus concentrating the hinge action to one place instead of the stress being distributed over the whole bends.

Occasionally cracks will form in the curves which unite the crown and sides of fire-box. These are due to hinge motion and restricted expansion, caused by rigidity of copper staying, *i.e.*, that the top row of stays is too close to the bends.

Whilst alluding to copper staying and the 4in. pitch, it too often happens that with the rise of pressure recourse is not only had to increasing the diameter of stays, but also to reducing the pitch, more particularly at the curved portions of the box just above the line of frame. Now, the united resistance which such stays offer to the free upward expansion of a fire-box merits some attention, as the ideal boiler, if possible, should not suffer from any additional strains beyond that imposed by the pressure.

The more rapid wear of the lower part of the fire-box, particularly at the sides, ranging from 2in. to 3in. above the grate bar level to about 2ft. upwards, merits attention, being directly traceable to several causes, some mechanical, others chemical. The wear by mechanical action—firing—both in locality and severity, faithfully represents the system adopted. The left side of fire-box as a rule, suffers the most, for in throwing the coal to the right and left to prevent drawing air too rapidly, the manual effort for the left throw is, as a rule, greater than that to the right. The next form of mechanical action is that produced by sharp blast action on a well-burnt fire, causing the lighter and well-burnt portions to lift with a miniature volcanic action, which at the sides is incessantly abrading. The chemical action—pitting—so often noticeable in soft copper plates is produced by the emanations from some kinds of both bituminous and anthracite coals in the earlier stages of combustion, which occasionally bite deep into the plates, more especially when assisted by local leakages of stays or tubes. This 2ft. belt or zone of the box represents an area where

the greatest generation of steam is attained on the sides and ends, and, as a consequence, the scale should form thicker and quicker there than elsewhere, but this is not actually the case, for it is somewhat singular that those ingredients, which are first liberated from the water, and take form at a lower temperature, such as carbonate of lime (calcium carbonate), and, indeed, all other earthy matter, by virtue of their lighter specific gravity, are more or less dispersed by the action of convection, and either take to the quieter region of the outer shell or cling to the threaded surface of stays; but the calcium sulphate, produced at a much higher temperature, adheres to the generating surface with great tenacity. These accretions are at once cemented to the surface at the moment of conversion from water to steam, each globule formed leaving its light deposit, like a film, clinging to the plate. Such deposits, layer over layer, slowly form a crust of thin hard scale impervious to the water, the result being that, where the plates are subjected to high temperatures resulting from heavy trains at express speeds, and deprived of water contact, they become abnormally hot in this locality and weakened; the pressure with the extra expansion on the fire side causes them to bulge to a more or less appreciable extent, whilst the waste by heat and attrition is also rapidly going on. By the use of properly made rods, an effective system of washing out, aided by search-lights, will be successful in removing the softer and earlier deposits; but the removal of the harder scale from the surface of the copper plates is a work of great difficulty, as it almost becomes a part of the plate, and is further secured by its firm hold around the stays. Much, of course, depends on the quality of water; the worst form is instanced here.

It may be truthfully said that no place suffers so early or more assiduously than the mouthpiece—that portion of the plates, with the block ring between, which make the firehole. This is not at all surprising, considering that it is subject to wear by mechanical action more than any other part, and with greater fluctuations of temperature. It is the meeting place of those elements necessary for combustion. Any projecting rivets suffer from the back lash of flame and erosive gases, which play around its edges and projections.

The evil effects of sudden great differences of temperature on the mouthpiece ring and plates are very marked. Strong block rings are at times pulled asunder, and leakage more or less with some engines is almost chronic. The wear of the copper plate, particularly round the bottom half, due to dribbling the coal to fill up the back part of box, along with the rapid and more local wear by fire-irons, assist to make the condition of this part one to demand early attention. The wear by fire-irons can be partly dealt with by putting on shield plates, and trouble with broad-ringed mouthpieces and long rivets partly avoided by uniting the outer and inner plates—steel and copper—by means of outer flanges, whose edge will form the abutment for the door.

This system, however mechanical, is not free from trouble, for although the seams and rivets are away from the fire, still the cold inrushing air, when the door is open, affects them to leaking. It requires greater protection against the wear by fire-irons, and when worn out is more difficult to patch.

PROGRESS OF WARSHIPS AND MACHINERY BUILDING IN ENGLAND.

IN the issue of this journal for June 29th ult., and in an article under the heading above, we were enabled, through the courtesy of the various firms mentioned therein, to inform interested readers as to the progress made in the previous half-year with the warships and their machinery building in the private shipyards and engineering establishments in England; and from sources at command other than our naval authorities—by whom we, in common with our contemporaries and the general public, are kept uninformed—the work effected in this connection in the Royal dockyards of the country. As the year 1900, and with it another century of time, will have run their course in a few days after the publication of this issue of THE ENGINEER, we have thought fitting before the twentieth century dawns upon us, to give a similar *résumé* of progress made during the latter half of the expiring year.

At the time of penning the article just referred to, the nation was in daily expectation of the distribution of the work embraced in the First Lord's new Naval Programme, but the wheels of the Admiralty motor move but slowly, and the interested ones had to "possess their souls in patience" until the end of October, when the distribution list was officially published, to which we shall presently refer.

Giving the Royal dockyards priority of place in our notice, there are still in hand in them the following new constructions:—Portsmouth and Pembroke respectively are building the armoured cruisers Kent and Essex, vessels 440ft. in length, 66ft. beam, and 9800 tons displacement, to be fitted with engines of 22,000 indicated horse-power; while a similar type of vessel, the Drake, but 500ft. long, 71ft. beam, and 14,100 tons displacement, with engines of 30,000 indicated horse-power, is also being constructed at Pembroke. Devonport and Chatham respectively have in hand the battleships Montagu and Albemarle; each 405ft. long, 75ft. 6in. beam, and 14,000 tons displacement, to be fitted with engines of 18,000 indicated horse-power; while there has been laid down at Chatham, at the beginning of this month, a second-class cruiser to be named the Challenger, which will be an improved Vindictive, but much more heavily armed than existing vessels of her class.

The vessels reported as "completing"—an elastic term—at the dockyards, are the battleships Formidable and London, and the cruisers Spartiate, Cressy, and Pandora at Portsmouth; the Irresistible, Venerable, and Albion battleships at Chatham; the Implacable and Bulwark battleships, and the Hyacinth cruiser at Devonport. Sheerness is completing the Vestal, Shearwater and Espiégle sloops, the last named only just launched. Of the actual state of forwardness of any of the dockyard's creations, we are, as before stated, by Admiralty injunction quite uninformed; but of the incomprehensible delays in the completion of many of them—money having long since been voted for the purpose—we are safe in asserting that such a state of affairs as now obtains has not existed within recent years.

With reference to the new ships included in this year's naval programme to be built in the Royal dockyards, they comprise a battleship, the Queen, and a second-class cruiser, the Encounter, at Devonport, similar vessels, the Prince of Wales and Challenger at Chatham; the armoured cruisers Cornwall and Suffolk, at Pembroke and Portsmouth respectively; Sheerness having allotted to it the sloops Odin and Merlin.

Turning now to the progress made by our private warship builders and marine engineers in England during the past six months, with such work as they have had in hand, we have pleasure in being the means of placing it on record at the end of the century now fast closing upon us.

Taking, as in previous similar records, the East Coast shipyards in order, coming south we first note that Sir W. G. Armstrong, Whitworth, and Co., of Elswick-on-Tyne, have completed and handed over to the Japanese Government the armoured cruiser Idzumo. She is a vessel of 9750 tons displacement, and attained on trial a speed of 22·04 knots an hour. The sister ship Iwate, for the same Government, will shortly be ready for her trials. The battleship Hatsuse, of 15,000 tons displacement, also for the Japanese, has successfully completed her trials, at which she attained a speed of 19·11 knots an hour, and will shortly be handed over to the Japanese naval representatives. All these vessels have Belleville boilers and triple-expansion engines supplied by Humphrys, Tennant, and Co., of Deptford.

Of the two coast-defence ships Norge and Eidsvold, built at the Elswick yard, the former has completed her trials, and will shortly be ready to hand over; while the latter will be ready for trial early in the New Year. These vessels are amour-clads, of 3850 tons displacement, built for the Norwegian Government, and fitted with triple-expansion engines and Yarrow water-tube boilers, by Hawthorn, Leslie, and Co. The Cobra torpedo boat destroyer, built at Elswick, but engined by the Parsons Marine Turbine Motor Company, has completed her trials with great success, and will shortly be handed over to the British Government. Of the six new armoured cruisers of the County or Essex class to be built for the British Government, the Elswick firm have secured the order for the Lancaster; the particulars as to her dimensions, armament, &c., we gave in a late issue of this journal.

The next firm in order is Hawthorn, Leslie, and Co., of St. Peters Works, and Hebburn-on-Tyne. The destroyer Havock, built and engined for the British Government by Yarrow and Co., of London, and originally fitted with locomotive marine boilers, has had these replaced by water-tube boilers of the Yarrow type by the St. Peters firm, completed her trials, and been taken over by the Government. The Viper destroyer, driven by turbine engines, has also completed her trials, on which she attained the unprecedentedly high speed of 37 knots an hour, and is now being taken over by the naval authorities. The 30-knot destroyers Greyhound, Racehorse, and Roebuck, built by the firm, are all launched; the first-named has her engines and boilers fitted on board, and will shortly be ready for trial; the second has the principal portion of her machinery on board; and the last, just launched, is now having the machinery put on board. The propelling engines of all these vessels are of 6000 indicated horse-power, supplied with steam by Yarrow water-tube boilers.

The battleship Bulwark—building at Devonport—has the whole of her machinery now fitted on board, and will be ready for trial early next year. The main portion of the engines for the armoured cruiser Kent—building at Portsmouth—are now ready to commence erection in the shops, and will be fit for the vessel about the middle of next year. The Belleville boilers for this vessel are also fairly progressing. Of the Norwegian armour-clad coast defence ships, Norge and Eidsvold, both built at Elswick, the machinery of which has been supplied and fitted by Hawthorn, Leslie, and Co., the first has passed through most satisfactory trials, and she is about to leave for Norway, and the trials of the machinery of the Eidsvold will take place early in the coming year.

It is worthy of note that Hawthorn, Leslie, and Co. have now on order three complete sets of machinery for first-class twin-screw cruisers of the County class, viz., the Kent, Lancaster, and Cornwall, the latter being two of the six armoured cruisers ordered for construction under the last new naval programme. The sets of machinery for each of the above-named vessels are of 22,000 indicated horse power, which, together with the machinery of the Bulwark, and the three destroyers before mentioned, make a total of 100,000 indicated horse-power of propelling engines in hand by Hawthorn, Leslie, and Co. for the British Navy.

At the shipyard and engine works of Palmer and Co., of Jarrow, good progress has been made in both the hull and machinery of the first-class battleship Russell, building by the firm for the British Navy. This vessel will have a displacement of 14,000 tons, and will be propelled by twin-screw engines of 18,000 indicated horse-power, supplied with steam by Belleville boilers. The hull is plated and completely riveted up to the armour shelf; the plating and framing behind the armour, and the teak backing being finished, and a portion of the armour plates fitted and ready to receive the armour. The protective decks are finished, and the topside framing, with outside stringer and deck plating, are completed. The engine and boiler seatings and bunker bulkheads are finished; and those forming the magazines and store-rooms, &c., are well advanced. The propeller shaft brackets are in place, and the shell plating round the shafts completed. The bow plating, with that for stiffening the ram, is finished. Internally good progress is being made with the fitting and other work. Altogether fully three-fourths of the total weight of material in the hull is worked in, and the launch of the ship is fixed to take place next February, the stern shafts and propellers being in place, and practically ready.

The machinery of the Russell, supplied by her builders, is making good progress, the engines being in course of erection in the shops, and the whole of the work on them and the boilers is well advanced, notwithstanding the difficulty experienced in obtaining delivery of the material of the Belleville boiler tubes. As the Russell's boilers are the first of the type constructed at the Jarrow works, and special machinery and appliances, &c., had to be provided for making them, their delivery and fitting on board is still expected to be in good time.

In addition to the battleship Russell, Palmer's Company has had in hand for the British Government the three 30-knot torpedo boat destroyers, Myrmidon, Kangaroo, and Syren, ordered last year. Of these the first two have successfully passed their preliminary full-power and speed trials, and are rapidly being got ready for delivery at the dockyard; while the machinery and boilers for the third vessel—already launched—being ready, no delay will occur in preparing her for her speed trials. The propelling engines for these vessels, which have each a displacement of 320 tons, are of 6000 indicated horse-power, supplied with steam by water-tube boilers of the Reed type, made by the builders of the vessels. From the progress made with the work now in hand for the Admiralty, it may be anticipated that the Jarrow firm will not be overlooked in any future distribution of naval work.

Although temporary financial difficulties still affect the naval work in hand at Earle's Shipbuilding and Engineering Company's works in Hull, progress has been made towards the completion of the first-class battleship Formidable, built at Portsmouth, the engines and boilers and all the auxiliary machinery having been now fitted on board. The basin trials of the vessel will be commenced early in January next, and the official trials will follow during February. The engines for the sister ship London, also completing at Portsmouth, have been delivered to the dockyard, and partly fitted on board. One group of boilers is also completed, and is in course of erection on board, and the remaining two groups are well advanced towards completion at the company's works. The engines of both ships are of 15,000 indicated horse-power, supplied with steam by Belleville boilers, but great difficulty has been experienced throughout their construction in obtaining delivery of sound tubes; the tube makers being unable to produce them good enough to satisfy Admiralty inspection.

From Hull southwards, there is no warship building till the Thames is reached, where, at the Orchard Yard, Blackwall, the Thames Ironworks Company has in process of building for the British Government, the two first-class battleships Duncan and Cornwallis, the work upon which has been proceeding very fairly since June last, there being now over 5000 tons of material built into the first-named ship, and more than 4700 tons into the latter. The work has, however, been much hampered by the delay in the receipt of the armour from the makers. All the bulkhead armour—with the exception of the closing plates—has been received and fixed on the Duncan, and the fixing of the similar armour on the Cornwallis is now in hand. A few plates for the armour belt of this vessel have come to hand, but none of the armour for the casemates on the main and upper decks—though wanting for many weeks—has as yet been received, its absence considerably interfering with the normal progress of the work.

Delay has also been occasioned by the want of a sufficient number of riveters, platers, and drillers to expedite the work. To supply to some extent this deficiency, the company has recently introduced a pneumatic tool installation, which is found of great assistance for drilling, chipping, caulking, and riveting. Electric drills, of the manufacture of which the company make a speciality, supplying them as they do to all the principal shipyards in the kingdom, are also found of the greatest use, in view of the continued scarcity of skilled labour in the shipyard. The Duncan will be launched towards the end of next March, and the Cornwallis about two months later.

The propelling machinery of these battleships, which is being made at the company's engine works at Greenwich, is making fair progress, the erection of the main engines of the Duncan being so far completed in the shops that they will be ready to fix on board by the time the ship is launched. Her twenty-four Belleville boilers are also in a very forward state, eight of them being now fitted on board the ship, and it is anticipated that the whole of them will be fixed in place before the ship is launched. The engines and boilers of the Cornwallis are making good progress, but are not yet erected. The machinery for the battleship Albemarle—building at Chatham—to be supplied under contract by the Thames Ironworks Company, is now well in hand, a very large part of the details being already machined. That of H.M. sloop Shearwater, of 1400 horse-power, has been completed and fitted on board; the vessel has passed through her trials, and has been finally accepted by the Admiralty. The engines and boilers of the ten 56ft. and nine 45ft. steam pinnaces—now building at the company's shipyard at Blackwall—are in a forward state; six sets have already been fixed on board the boats, and will shortly be commencing their trials. The battleship Albion, built by the Thames Ironworks Company, was delivered to Chatham dockyard early in September.

Yarrow and Co., of Poplar, are just finishing the ten 27-knot first-class torpedo boats built for the Japanese Government, and have in hand for their navy two more 31-knot destroyers. There are also in hand, at the Poplar

yard, three first-class torpedo boats for the Dutch Government, and two shallow-draught twin-screw gunboats for the British Government, these being 160ft. long, and 2ft. 3in. water draught when loaded; the speed being 18 knots an hour.

The firm's type of water-tube boilers, of which many are now in hand at their works, is coming rapidly into use by foreign Governments. In Holland and Sweden the experience had in their use has been most satisfactory, this type of steam generator being fitted in all their large ships. The Austrian Government has also used them with such satisfactory results that, in their two large vessels now building, having 13,000 and 14,000 horse-power engines, Yarrow boilers are being adopted for supplying them with steam.

Humphrys, Tennant, and Co., of Deptford are making good progress with the machinery, &c., of the first-class armoured cruiser Drake, building at Pembroke. This vessel, it will be remembered, is to be of 14,000 tons displacement, and to have engines of 30,000 indicated horse-power, the first of this large size ordered by the British Government. The hull of this vessel is so far advanced in construction that the engineer contractors are now boring out the stern shaft brackets. There is also nearing completion at the Deptford Pier Works, machinery for warships building in this country for the Japanese navy; and the shops will shortly be preparing to start the construction of the propelling engines, &c., of the new armoured cruiser Berwick, just ordered to be built for the British Government by Beardmore and Co., of Glasgow.

Maudslay, Sons, and Field, of East Greenwich, have during the past six months been engaged in completing and fixing on board the machinery, and carrying out the trials of the battleship Albion, of 13,500 indicated horse-power, and of the first-class cruiser Spartiate, of 18,000 indicated horse-power. They have also in hand at Chatham the completion and fixing on board, the main engines and boilers and auxiliary machinery of the battleships Irresistible and Venerable, each of 15,000 indicated horse-power; and at the works at East Greenwich, all the boilers and gear connected with them for the Austrian coast defence ship Hapbsburg, of 11,900 indicated horse-power, all of the above-mentioned vessels being fitted with Belleville boilers.

J. I. Thornycroft and Co. at the Chiswick shipyard have completed the following vessels:—The Albatross and Stag destroyers, built for the British Government, which vessels on their trials attained the speeds of 32¼ and 31 knots an hour respectively; the 30-knot destroyer Usugumo, for the Japanese Government; the Argus and Vigilante, river gunboats, together with their un-named tenders, for the French Government. These gunboats, which are of the British Woodcock and Woodlark type, draw 2ft. of water, and are propelled by Thornycroft screw turbine propellers. They were sent out to Hongkong in sections, and are now in service on the West River.

At the Chiswick yard there are also in hand four first-class torpedo boats of a new type for the British Government, which are to carry a load of 40 tons on trial, and attain a speed of 25 knots; two new destroyers of the Usugumo class, but larger and a knot faster, for the Japanese Government; a stern-wheel steamer of 200 horse-power to work on the Congo, the largest of this type yet built for missionary work, she being intended for the Region Beyond Missionary Union; together with several steam launches.

On the West Coast, the first-class battleship Glory—built by Laird Brothers, at Birkenhead, for the British Navy—has been entirely completed, passed through her steam and gun trials, been put in commission, and sailed for China. The Exmouth battleship for the same service is rapidly approaching a state fit for floating out of dock, having now about 4500 tons of material worked into the hull, exclusive of armour; a quarter of the heavy citadel armour being also in place. The machinery for this vessel now being erected in the shops, is well advanced.

Of the two single-screw sloops Mutine and Rinaldo, built by Laird Brothers, the former has made a satisfactory preliminary trial on the Mersey, and has left for Sheerness Dockyard; the sister ship Rinaldo will follow very shortly. The preliminary trial of the 30-knot destroyer Lively has been made, and she has just left the Mersey for the Clyde, where her official trials are to be carried out; while the preliminary trials of the sister vessel Sprightly will shortly be made.

The machinery of 15,000 indicated horse-power of H.M. battleship Implacable made by Messrs. Laird, has been fitted on board at Devonport Dockyard, and a satisfactory basin trial has been made, and she will shortly proceed for trials at sea. The machinery, also of 18,000 indicated horse-power, for H.M. battleship Montagu, building at Devonport, is in a forward state in the shops, and the underwater fittings and stern shafts will be in place in the ship in time for her proposed launch next March. A set of water-tube boilers of the Laird type recently made for H.M. third-class cruiser Blanche has been fitted on board, and the vessel has made satisfactory trials; a similar set for the sister ship Blonde are in process of construction in the boiler shops.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet engineer: J. P. Thomas, to the Vernon, additional for Torpedo Depôt, Portsmouth Yard, to date December 12th. Staff engineers: C. A. Moore, to the Mars; F. H. Dart, to the Blenheim. Chief engineer: G. Pascoe, to the Duke of Wellington, additional to the Brilliant. Engineers: J. Thomson, to the Raven; W. H. Murray, to the Blenheim; O. A. Morris, to the Pembroke, for the Mallard; H. R. Batchelor, to the Pembroke, for the Salmon; P. C. W. Howe, to the Duke of Wellington, for the Charger. Assistant engineers for temporary service: G. R. Byles, H. O. Andrews, and H. L. M. Ford. Assistant engineers: G. Moore, S. U. Bardcastle. Probationary assistant engineers: F. W. Bromley, J. R. Macey, all to the Blenheim. Artificer engineer: W. J. Morrell, to the Collingwood.

A RUN FROM ADELAIDE TO SYDNEY.

(From Our Own Correspondent.)

ADELAIDE being the furthest point in railway communication with the eastern colonies, is therefore the first port of call for the oversea steamers, where the mails and passengers can be landed for quick despatch to other parts of Australia.

The Peninsular and Oriental, Orient line, Messageries Maritimes, and Norddeutscher Lloyd having a regular service, receive or tranship their oversea mails at this port, and passengers who wish to save time catch their steamer or embark here.

In describing the run of the express from Adelaide to Sydney, it must not be expected to vie with the speeds attained in Europe or America; in the one case the roads have not had the money spent on them to make them such permanent structures as in England, nor is the traffic so dense as to necessitate the heavy loads running on the American railways. On the other hand, some of the gradients are so severe and curves so sharp as few railways have to contend with, and anything like them would prevent high speeds under any consideration.

For the purpose of giving a description of the long run from Adelaide to Sydney, 1059 miles, the writer commenced his journey from Adelaide by the express on the 14th June last, leaving that city at 4.30 p.m. This was a typical every-day run as per ordinary time-table, excepting on this occasion, the train having one carriage in excess of the ordinary train load, an assisting engine was attached as far as Murray Bridge. Had it not been for the one extra carriage the train would have been hauled by one engine.

The train consisted of the following vehicles;—One second-class ordinary bogie carriage, two second-class corridor cars, two first-class corridor cars, one first-class boudoir sleeping car, and two express passenger brake vans. These vehicles provided accommodation for 196 passengers, and nearly all the seats were occupied, giving an effective load, without engine and tender, of 169 tons 11 cwt. The engines had six wheels coupled, and a bogie in front, driving wheels 54in. diameter, and cylinders 18in. by 24in. stroke, the makers being a Colonial firm, Messrs. J. Martin and Sons, Gawler, South Australia. The total length of the train overall was 466ft. 4in.

It will be noticed in the log of the runs, particularly in South Australia and Victoria, that the express stops at a number of stations; this is because the traffic is not extensive enough to warrant an extra train running to stop at all stations. In like manner, the engines are changed rather frequently; this is done for the purpose of utilising the engines in back loading more economically than if one engine took the train through.

As the through line to the Victorian border is only single line, with the exception of one mile out of Adelaide, the trains require to slow down at crossing stations to exchange staffs; this considerably reduces the speed that would otherwise be maintained.

A start was made from Adelaide, to time, under fine weather conditions, the run to Mitcham (5 miles 26 chains) being easy, when a grade varying from 1 in 50 to 1 in 45 is met with for over 14 miles; this is the steepest part of the road for the entire section. The seventh mile-post was passed at the rate of 18½, the ninth at 22½, arriving at Blackwood (11 miles 42 chains) at 21½ miles per hour, where the first stop was made. Continuing up the 1 in 50 grade, an average rate of 18¾ miles per hour was maintained until the summit was reached (19 miles 41 chains). The down grade to Ambleside (27 miles 15 chains) was run at 23, then a rise to Balhanah being run at 34½, where the up train was crossed; an up-grade of 1 in 75 and 1 in 51 brought us to Mount Barker at 22½, when, after a run down a slight grade for three and a-half miles at 30¼ miles per hour, Nairne was reached, where water was taken. After leaving Nairne a down-grade, ruling 1 in 45 for 11 miles, is met with until Callington is passed, when grades of 1 in 45 and 1 in 49 for over a distance of two miles are climbed, after which a down-run is made to Monarto (51 miles 29 chains), where tickets were collected—still continuing the down-grade until nearing Murray Bridge, the train was slowed down for a considerable distance, owing to interlocking repairs going on, the average speed over this run being at the rate of 30½ miles per hour. Here a change of engines was made, one engine then taking the train on to Serviceton, the end of the South Australian line. This engine was No. 136, by the same colonial makers, and is a four-wheel coupled, with a bogie in front, the driving wheels being 78in. diameter; the cylinders are 18in. by 24in. stroke. The run from Murray Bridge until nearing the Victorian border is through almost level country. Soon after leaving the former station the ninety-mile desert is entered, when a flat, uninteresting country is passed through, nothing but stunted bushes relieving the otherwise sandy landscape, the cold wind in passing through this stretch being severe.

A steady steam pressure of 140 lb. was maintained throughout the journey, and in no case were the engines pushed for steam, and the firing was conducted with such regularity that on no occasion throughout the run did steam blow off, nor did the pressure vary 10 lb.

The line from Adelaide to the Victorian border is laid with 61 lb. steel rails, and has a ruling grade of 1 in 45. This line, as well as the Victorian portion, which runs to Albury, being 5ft. 3in. gauge, the trains run very steadily whatever the speed, and this allows one set of carriages being run between Adelaide and Melbourne.

Serviceton to Melbourne.—At Serviceton the watch required setting forward thirty minutes to come up to the Melbourne time, which is uniform throughout the Victorian Colony. Here a Victorian engine took charge of the train. It was one of Beyer and Peacock's, four wheels coupled, bogie in front, with 72in. driving wheels. Over a fairly level road a speed of 39 miles per hour was maintained before the first stop—14¼ miles distant; from here to Nhill, the next stop, the line presents a series of short grades, the highest being 1 in 50, of about 1½ miles in length. A fairly even run is then encountered to Dimboola, 28½ miles, where a change of engines is made, No. 198 being taken on, of the same class and makers as the former one. After running up a 1 in 50 grade, after leaving the station, the mean altitude varies only 169ft. in 68 miles, until nearing Stawell, when a mean rise of 161ft. is made in eight miles. Again a change of engines is made, No. 406 being of the same class and size as the former ones, but it has been built by a colonial firm, viz., the Phœnix Foundry Company, Ballarat, Victoria. Leaving Stawell, which is at an altitude of 757ft. above sea level, the contour of the country now changes considerably. The line undulates in a series of up-and-down grades until a maximum altitude of 1516ft. is reached, near Ballarat, a number of 1 in 50 grades being negotiated, and one of 1 in 44 being met with near Beaufort. We arrived at Ballarat at 7.15 a.m., where a stop of twenty minutes was made for breakfast. Engine No. 242 now takes on the train. This is another engine built by the Phœnix Foundry Company, but this one has 60in. driving wheels. A climb of 524ft. in twelve miles brought us to Wallace Station in twenty-six minutes, when a drop of 1 in 50 for two miles was done at 45 and 50¾ miles per hour. After passing Gordons Station a gradual fall takes place to Ingliston, the mile-posts being passed at the following speeds, 50¾, 51½, 54½, 52½, 45, 51½, 51½, the engine running perfectly steady all the time. From the latter station a fall of 1 in 48 for 12½ miles is run, and as the road had been recently relaid, a fine run was made to Bacchus Marsh, every mile-post being passed at over 50 miles per hour rate; in fact, the six minutes lost time was easily pulled up during the run.

Leaving Bacchus Marsh three minutes late, a rise is made to 464ft. at the 29 mile-post, from where an easy fall to 30ft. is made to Melbourne, where we arrived at 9.58 a.m., being three minutes behind time-table time.

Steam was kept at a pressure of 130 lb. at the early part of the journey, increasing to 140 lb. when the hilly country was traversed. The ruling grade from Serviceton to Melbourne (286½ miles) is 1 in 48; the permanent way is laid with 75 lb. and 80 lb. steel rails, while only 15 miles 64 chains of the distance is double line.

Melbourne to Albury.—A separate train is made up for the Sydney express, which leaves Melbourne at 5.15 p.m. daily. On the occasion of this trip the train consisted of the following vehicles:—One express passenger bogie brake, two first-class corridor cars, two second-class corridor cars, and one composite bogie carriage (off at Seymour); the effective load, without engine and tender, being 178 tons 19 cwt. The engine hauling this train was No. 410, which ran to Benalla, 121¼ miles; the train was then taken on to Albury by engine No. 408, 69¼ miles. Both these engines were made by the Phœnix Foundry Company, and are four wheels coupled, with a bogie in front, with cylinders 18in. diameter by 26in. stroke, and driving wheels 72in. in diameter. Steam was kept at an even pressure of 160 lb. throughout the journey. Starting from Melbourne in fine, clear weather, we soon ran into a heavy mist, so thick that the stations were hardly discernible. A continuous up-hill grade is met with up to the 33 mile-post, when the highest point on this section is reached, 1147ft. From there the run is over undulating grades, principally down-hill, to Seymour, which stands at an altitude of 464ft., where the first stop was made—the 61¼ miles being run at the rate of 37¾ miles per hour. Travelling on the engine over this section was very rough compared with the other part of the journey. A vast difference is, however, experienced on riding in the carriages, the bogies taking the curves so readily that scarcely a vibration is noticed. After a delay of 14 minutes at Seymour, which was occasioned by the water hydrant working badly, the run was made to Benalla, over fairly level country, arriving there ten minutes late, where the change of engines was made.

The run through to Albury is over fairly level road, excepting at Glenrowan, where a rise of 1 in 75 is faced, the train arriving at Albury at 10.51.30, only 1½ minutes late, in the last 96¾ miles 10½ minutes having been pulled up.

The engines were not at any time pressed for power, but as the line is single for 124¼ miles, the speeds are very much reduced by the frequent slowing down in passing stations to exchange the staffs.

Albury to Sydney.—Owing to the break of gauge at Albury separate trains are run from there over the New South Wales 4ft. 8½in. lines. As the length of journey from Adelaide was too great to admit of the times being taken throughout to Sydney, the record of a journey from Albury to Sydney, taken by the writer some time previously, is given here.

The engine hauling the train now is, however, of an improved type, known as the "T" class; these engines have given remarkable results over the heavy grades and sharp curves characteristic on the New South Wales lines; they were designed by the chief mechanical engineer, Mr. W. Thow, and embody all the qualities of the imported English and American engines. These engines are eight-wheel coupled, with a pony in front, and driving wheels 51in. in diameter; the extended fire-boxes are a special feature of these engines, which have a total heating surface—including tubes—of 2198 square feet, and a grate area of 29¾ square feet. An effective load of 155 tons 18 cwt. is now hauled with these engines on the express from Albury, consisting of one express passenger brake, one first-class lavatory carriage, one Pullman sleeping car, one first-class vestibule corridor car, and one second-class corridor car, covering the distance from Albury to Sydney in the same time as the run under review.

On the trip under notice an exceptionally light train happened to be running, the effective load being 103 tons 4 cwt., and was run from Albury with one of Dubs' four-wheel coupled express passenger engines, with cylinders 18in. diameter by 26in. stroke, and driving wheels 72½in. diameter.

Leaving Albury, a gradual rise is encountered until the 377 mile-post is passed, when the line runs with varying grades to Wagga Wagga—77 miles. In this distance the mile posts were passed 44 times at speeds exceeding 50 miles per hour. Between Wagga and Junee grades are met with as high as 1 in 45, 1 in 46, 1 in 50, and 1 in 83, for considerable distances.

At Junee the engine is changed, a "P" class, No. 479, being coupled on. This is a four-wheel coupled express, built by Beyer, Peacock, and Co., with 60in. driving wheels. From here the run is over very rough country, a continuous series of up-and-down grades, the line rising to a height of 2392ft. at Cullerin, being a mean altitude of 1047ft. in 133 miles from Junee. Numerous grades of 1 in 40, ranging from half a mile to two miles in length, are mounted in travelling over this section. After a run of 153 miles the engine is again changed at Goulburn, another of the same class, No. 475, taking the train on to Sydney. Steam is kept throughout at a pressure of 160 lb. per square inch. At Hill-top, 68¾ miles from Sydney, the line begins a sharp descending gradient of in 30 and 1 in 33, dropping from an altitude of 2026ft. to 74ft., a mean of 1952ft. in 41 miles, when the run from this on to Sydney does not call for special comment, the last 28 miles being run at an average speed of 40 miles an hour.

From Albury to Yass, 199¼ miles, the road consists of 71½ lb. steel rails, from there on to Sydney 80 lb. rails are laid. Of the total distance 333 miles is run on single line.

COMPETITIVE plans for a sewerage system at St. Petersburg will be received until August 31st, 1901, by a municipal commission. There will be prizes of £1296, £820, and £420, respectively, for the best three plans.

THE THAMES PASSENGER STEAMBOAT SERVICE.

No. VI.

FROM the absence of any railway competition with the above-bridge passenger steamboats in the decade 1840 to 1850, they appear thus early through the adoption of the principle of exacting moderate fares for service rendered to their patrons, to have been fairly successful financially; for we find that in 1846, when there were eleven boats running between London and Westminster bridges, at a fare of 1d. per trip—which had for some time previously been 4d.—£125 was about the daily receipt of these boats; the trip occupying from a quarter to half an hour. Equal success, at the same date, attended the "long ferry" boats—below-bridge—as the number of persons landed at Gravesend in the year had amounted to 1¾ millions.

This increase of visitors and others to Gravesend had brought about the duplication of the area of the town, the number of the landing piers, and steamboat companies. But there was trouble brewing for the latter in the near future. The year 1849 saw the completion and opening of the railway from London to Gravesend, which soon caused a complete diversion of the river passenger traffic to itself, and the fine steamboats that had been employed in it had to be sold, and the companies owning them dissolved. Under different financial positions than then obtained with them, the two principal companies, the "Diamond" and the "Star," might have struggled on for a time, but the charges exacted from them throughout their existence, for landing passengers at the river piers had been so heavy that neither had been able to create a fund for such a contingency.

A then well-known contributor to the *Nautical Magazine*, speaking on this subject—pier dues—some time after the formation of the "Diamond" and "Star" steamboat companies, said:—"The wharf owners at London Bridge had the modesty to ask 3d. from every person journeying to and from Gravesend, and 6d. to all places below that town. The annual receipts from passengers by steam alone must amount to quite £30,000 per annum; infinitely more than the value of the wharf property. The consequences of this monopoly will be the almost certain ruin of the small steamboat companies; for it appears that the London and Greenwich companies are without a farthing to pay dividends, while they have paid about £6000 in one year to this wharf. The 'Star' Company had no dividends, having paid about £3000 for wharfage; the 'Diamond' Company £3000; and other parties in proportion." This writer goes on to say:—"The charges are so enormous that unless something is done by the Government for the public protection, many of these steamers must cease to run altogether, and the public be debarred of one of the most rational modes of recreation that can possibly be found." He further testified:—"That the immense number of persons then annually embarked and landed in the port of London, from the steamers alone, was fully two millions; and that one penny a head for sea voyage passengers, and a halfpenny for river ones, would be an ample remuneration as wharfage dues."

The boats of the "Diamond" and "Star" companies detailed in a previous article—engaged in the Gravesend passenger service, at the date of the opening of the Gravesend Railway—were unequalled in point of speed, beauty of form, and deck and saloon accommodation; and they were not only good river boats, but good sea boats as well, as their ultimane fate—so far as is known—which we shall briefly detail later on, will show.

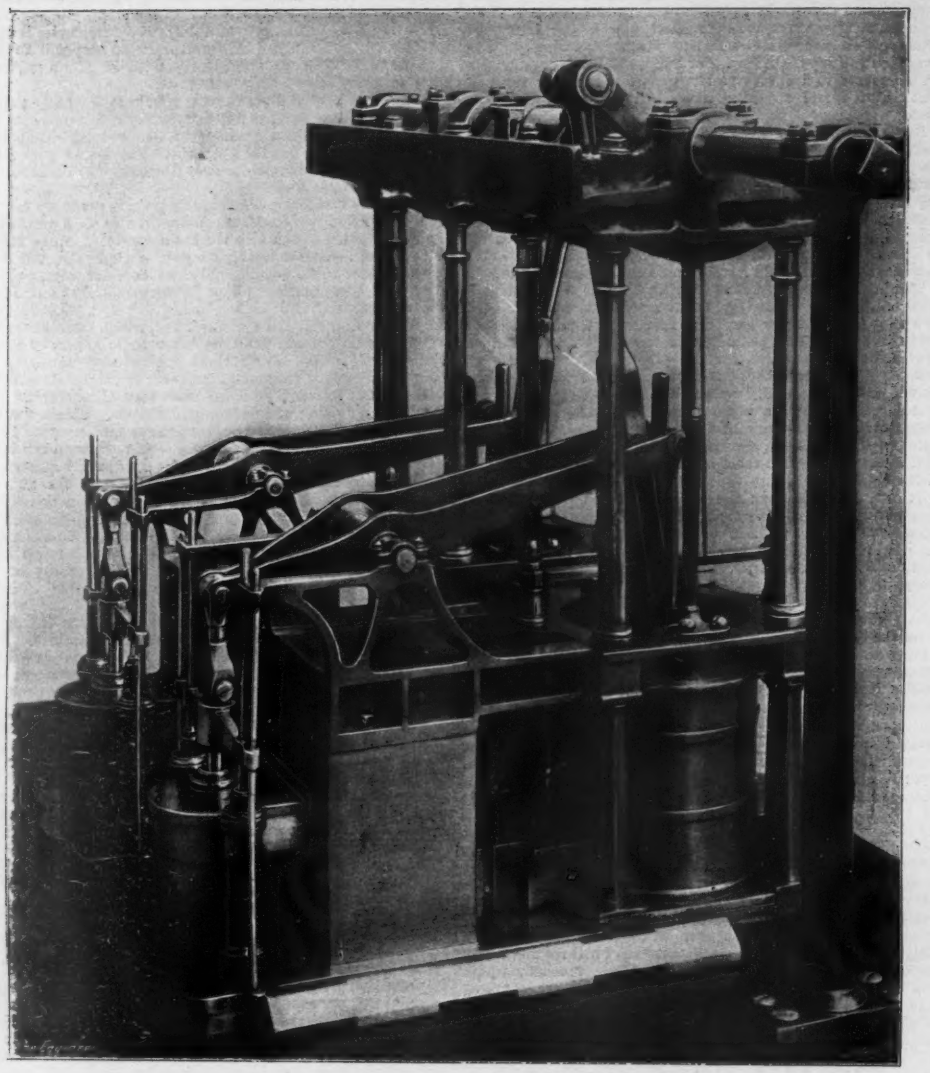


Fig. 1—TYPE OF ATMOSPHERIC ENGINES FITTED IN P.S. SAPPHIRE

Before recording that fate, a brief description of the most noteworthy of these boats may be interesting to present readers, in view of the class of boat there is some probability of our seeing plying on the Thames, under the auspices of the London County Council.

Of all the boats in the "Diamond" Company's service, the Ruby was generally acknowledged to be in every respect the best. In the issue of this journal of October 15th, 1897, was given an illustration and description of this beautiful craft, and of her engines, to which we would refer those interested in former river steamers for full particulars; but to those not within reach of previous issues, the following brief description of the Ruby and her machinery may be acceptable. She was built expressly for the "Diamond" Steamboat Company with a view to great speed and ample passenger accommodation. She was 155ft. long between perpendiculars, 19ft. beam, 9ft. 6in. deep under deck, 272 tons burden, and with all machinery, coals, and passengers on board, her water-draught was 5ft. She was propelled by paddle-wheels driven by a pair of Seaward and Co.'s side lever engines of 50 horse-power each, which gave her a speed in still water of 13¼ miles an hour; or greater than that then attained by any vessel in the kingdom by nearly half a mile; she having made the passage from London Bridge to Gravesend—with the tide—including all stoppages, in an hour and forty minutes.

The Ruby's passenger accommodation was perfection, and consisted of a ladies' cabin 14ft., a saloon 32ft., and a fore cabin 32ft. long; each of them admirably fitted with every convenience for the travellers' comfort. She would carry with ease 800 passengers, and could dine 100 in her saloon. She was designed by the son of Mr. Oliver Lang, the eminent shipbuilder of the time, and was built at Blackwall by Mr. Wallis, on Mr. Lang's patented principle. As this plan of building steamers was adopted in the case of the Gem, Diamond, Pearl, Topaz, Fairy, Naiad, Nymph, Ariel, &c.—Thames river steamers—it may be briefly described here

As the Ruby was to be of as light water draught as possible, no more timber was used in her construction than that necessary to give her the requisite strength, stiffness, and solidity. To effect this the construction was as follows:—The hull consisted of three thicknesses of oak plank, each plank being 1¼in. thick. The outside planks were placed horizontally as usual, but instead of frames or ribs to which to secure them, two thicknesses of plank were substituted, laid diagonally to the keel, but at right angles to each other, with felt between the layers; the whole three thicknesses of plank being fastened together by nailing, as in a clincher-built boat. Built in this way boats were found to be far less expensive, much stronger, and more durable than those built in the ordinary way. To confirm this fact, the Diamond—the oldest of the boats so constructed—on examination after four years of severe running, winter and summer, frequently making four passages to Gravesend and back daily, had not broken or altered her sheer line three-eighths of an inch from the day she was launched. Until the Ruby was put on the Gravesend station, the Star, belonging to the Star Steamboat Company, was equal in speed to any boat on the river; in fact, none could beat her, until the advent of a sister vessel of the same company, the Satellite, engined by Miller and Ravenhill with a pair of steeple engines of 35* horse-power each, supplied with steam by tubular boilers, which vessel attained a speed of 14½ miles an hour.

That a transfer of propelling engines is sometimes beneficial in the case of two nearly similar boats, was shown in that of the Gem and the Ruby, both belonging to the Diamond Steamboat Company, and running on the Gravesend route. The first-named boat, built previously to the Ruby, was 145ft. long, or 10ft. shorter than that vessel, but of similar beam, and was first fitted with a pair of side lever engines of 50 horse-power each, and her speed with them was 12½ miles an hour; but when the same engines were placed in the Ruby her speed with them was 13¼ miles in the hour. A pair of similar engines, but only of 45 horse-power each, were then put in the Gem, without in any way altering the vessel, when, in consequence of the diminished weight and draught of water, her speed nearly equalled that of the Ruby.

One other of the Diamond Company's boats, the Sapphire, is specially noteworthy on account of the type of engines with which she was fitted. She was an iron paddle steamer, built by Ditchburn and Mare, in 1842, and was of the following dimensions:—Length, 150ft.; beam, 19ft.; depth under deck, 9ft. 2in.; and water draught, with coals, passengers, &c., on board, 4ft. 8in. Her engines, fitted by Seaward and Capel, were on the old atmospheric principle, and consisted of three open-topped cylinders, placed side by side in line, immediately under the paddle shaft, the cranks being set at 120 deg., so that there was always one cylinder of full power in action, thus producing an equable and uniform motion. There were no cylinder covers or piston rods, the connecting-rods, which were forked at their lower ends, being coupled there direct to the pistons, and to the cranks at their upper ends.

The steam cylinders being open-topped, their pistons were forced upwards by steam pressure beneath them, and they were then allowed to descend by the atmospheric pressure on their top sides, a vacuum being formed below; the pistons being guided in their movement by round guide-rods attached to their centres, which passed through guides on the cylinder tops. The steam admission valves were of the gridiron type, each cylinder having one steam and one exhaust valve, worked by cams on the crank shaft instead of excentrics. The diameter of each of the cylinders was 47in., and the piston stroke 3ft., thirty four strokes being made per minute; the steam pressure used being about 8 lb. per square inch.

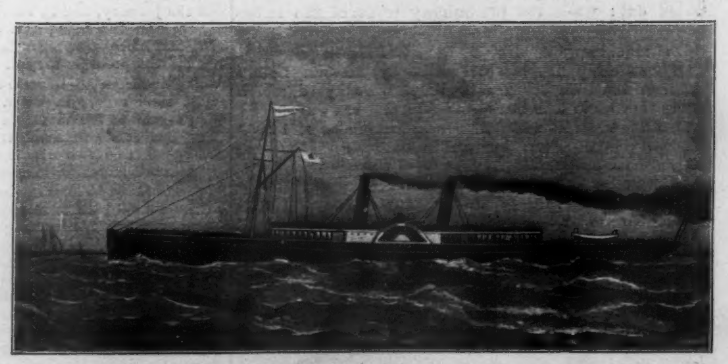


Fig. 2—P.S. PRINCESS ALICE

The estimated power of the engines was 100 horses, driving a pair of paddle-wheels 16ft. diameter, fitted with twenty-four floats.

On trial the Sapphire proved to be of unrivalled speed. She made several trial runs between Blackwall and Gravesend, when the engines worked admirably, making from thirty-three to thirty-four strokes a minute. On one of these trips she had a trial of speed with the

* These were nominal powers, and about one-third of the indicated power.

Railway—belonging to the Blackwall Railway Company, and supposed to be the fastest boat then on the river, her maximum speed being 15½ miles an hour—from Greenhithe to Blackwall, and beat her by two minutes. Another trip from Gravesend to Blackwall—twenty miles—was made in 1 h. 7¼ min., which was then the quickest passage on record between the two places. It was a low neap tide, and with the vessels, but not more than two miles an hour.

In Fig. 1 we give an illustration of the type of engines fitted in the Sapphire, but with only two cylinders instead of three. The air and feed pumps, it will be noted, are each driven by separate levers worked by links attached to each piston; but in the case of the Sapphire there was but one large air pump, actuated by a rocking beam connected by links to the piston of the middle cylinder, a feed and bilge pump being placed on either side of the air pump; their rams being attached to the air pump's crosshead in the usual way, an independent jet condenser being fitted, to which the air pump was connected.

On the introduction of this type of engine, objection was taken to the open-topped cylinders, it being argued that they formed receptacles for dirt, &c., but their makers showed that instances could be cited of similar engines running for years without serious wear to either cylinders or pistons. The use of three cylinders was considered an advantage, as uniformity in motion was thereby gained; and the high degree to which expansion could be carried out in them was conducive to economy of fuel.

Fig. 3—S.S. BYWELL CASTLE

After the stoppage and dispersion of the Diamond and Star Company's boats, the two Gravesend piers, over the establishment of which there had been so much contention by members of the Watermen's Company, went into Chancery, the Town Pier becoming a mere ferry pier, and the Terrace Pier a look-out house for pilots, which we believe they still remain. The actual ultimate fate of all of the Diamond and Star Companies' boats has never, we believe, been determined; but, from a paper on "River Steamers," read at the Institution of Civil Engineers, at the end of 1879, we learn that, of the boats of the Diamond Company, which were engined by Seaward and the Penns, and of the Star Company, mostly engined by Miller and Ravenhill, the following was their ultimate fate:—Of the Diamond Company: The Diamond was sold and broken up, the Ruby and Sapphire were sold to the General Steam Navigation Company, the Emerald (new) was sold and converted into a schooner, and the Emerald (old) was sold to the Licensed Victuallers' Company, and ran to Boulogne. Of the Star Company: The Medway was broken up, the Comet was sold and ran from Hartlepool to Sunderland, and the Mercury and Star were sold to the General Steam Navigation Company. The Jupiter and Venus were sold, one running from Dover to Calais, and the other to Guernsey and Jersey. The Satellite was also sold and went to Liverpool.

At the advent of the new boats of the Diamond, Star, and other companies on the Gravesend, Margate, &c., routes, the older boats, such as the Thames, London Engineer, Favourite, Royal Sovereign, &c., were relegated to "excursion" service. When the river passenger traffic was in its heyday—about 1845 to 1850—every town and village on the river's banks from Gravesend to Kingston possessed its own landing-place, and the river had become one great highway for the conveyance of passengers by steam. Below bridge there were 23 steamers running to Gravesend, 28 to Greenwich and Woolwich, calling at the Tunnel Pier, Limehouse, Commercial Dock, and Blackwall on their way; three ran between Greenwich and Blackwall only; and 10 between London and Herne Bay, Southend, Margate, and Ramsgate.

The extension of the railroad system of transit westward from London, on the Surrey side of the Thames to beyond Richmond, having soon followed the opening of the line to Gravesend, and the subsequent construction of the Victoria Embankment, and with it the London District Railway, on the Middlesex side—completed in 1870—had a most marked effect on the above-bridge river steamboat traffic; insomuch that with the exception of a new boat to replace a worn-out or inefficient one, the passenger service gradually deteriorated, until the occurrence of the disastrous loss of the Princess Alice, a saloon steamer belonging to the London Steamboat Company, through collision with a north-country steam collier in 1878. This appalling catastrophe proved a serious blow to Thames passenger steamers, as it caused an immediate falling off in the owning company's receipts, which never after approached in amount what they were before that event, representing as they did the money takings from nearly nine million passengers in the year.

Fig. 4—THE BYWELL CASTLE AND PRINCESS ALICE IN COLLISION

As the type and construction of vessel to be adopted for use under the new scheme of passenger steamboat service on the Thames, formulated by the London County Council, will be a matter of prime consideration, a retrospective view of the construction, &c., of the Princess Alice, and the causes that helped to her very sudden destruction, and the loss of so many valuable lives, will not be out of place here.

It is an admitted *sine quâ non* that a special service, such as that in which the Princess Alice was employed at the time she met with her disastrous fate, requires a special class of vessel to perform it effectually and satisfactorily. That the Princess Alice was not such a craft cannot, in the light of subsequent knowledge of her construction, be doubted. She was a vessel built in 1865 by Caird, of Greenock, for service as a passenger boat on the Clyde. Being found unsuitable for that purpose, she was sold to the London Steamboat Company, at which time she was practically a flush-decked vessel, 219ft. 4in. long, 20ft. 2in. beam, and 8ft. 4in. deep; or nearly eleven times as long as she was wide, an unusual proportion for such a craft. Her propelling machinery consisted of a pair of oscillating paddle engines—made by her builders—having cylinders 44in. diameter, and 8ft. 9in. piston stroke. Her hull—of iron—was plated both forward and aft with plates as light as they could well be—about $\frac{7}{16}$in. thick—while amidships they were somewhat stouter, the engines being carried on kelsons, which, with thicker garboard strakes and deck stringer plates, rendered her tolerably stiff. She had two water-tight bulkheads, one forward, the other aft, the machinery space lying between them; a structure, for a ship, as long and as weak as possible, and one that was then licensed by the Board of Trade to carry less than 400 passengers.

After purchase, the London Steamboat Company erected saloons on her deck, and increased her passenger accommodation. She was not classed at Lloyd's, and thus one guarantee that she was a strong and safe craft was lost to the travelling public. The superstructure in the shape of saloons built on her deck, of necessity added weight in a position to induce instability, which rendered her less seaworthy than before; yet she was granted a certificate to carry 899 passengers. In Fig. 2 we give an illustration of the vessel as she appeared afloat, which shows the length and height of the saloon that was constructed on her deck amidships; the top of it formed a promenade deck, which, on the day of the ill-fated excursion to Sheerness and back, was loaded with passengers.

As nearly a generation has passed since the great disaster occurred, in which this largest of the saloon passenger steamers owned by the London Steamboat Company was the primary figure, a brief description of it—with the assistance of the illustrations we give—may be of practical though mournful interest to our readers.

It was on September 3rd, 1878, the day being very sultry, and the evening muggy and close, that the Princess Alice, with about 700 passengers on board, left London Bridge about ten o'clock in the morning for a trip to Sheerness and back, calling at Gravesend both going and returning. The passage to Sheerness and back to

Fig. 5—BOW OF PRINCESS ALICE ASHORE

Gravesend, where the vessel landed some of her passengers, was safely made, and shortly after 6 p.m. she proceeded on to London. All went well until about 8 p.m., the boat being then within sight of the Royal Arsenal at Woolwich, when a large screw collier, the Bywell Castle, an illustration of which we give in Fig. 3, was seen approaching on the opposite course. Before anything could be done to avoid a collision, this vessel struck the Princess Alice on her starboard side, forward of the paddle-box, and literally cut her in half. Fig. 4 of our illustrations shows graphically the position of the two vessels at the critical moment of collision; immediately following which an appalling scene that had had no previous parallel ensued. In the succeeding few moments that the sundered parts of the doomed vessel remained afloat indescribable terror and confusion reigned.

As shown in our illustration, the greater part of the passengers rushed aft, as her forward end gradually sank in the water, and parted from the after part. The few lifebuoys on board, and the boats—seen hanging in the davits—were quite useless, as within five minutes of the moment of the two vessels colliding the Princess Alice heeled over and sank. The Bywell Castle stood by, and did all that was possible to save life, but, in spite of every effort, some hundreds of men, women, and children were drowned; no fewer than 623 bodies having been subsequently recovered. This great calamity spread a deep gloom over the whole of London, there being scarcely a district throughout the metropolis which did not contribute to its victims.

In Figs. 5 and 6 we give sketches of the forward and after ends of the Princess Alice after they were recovered and grounded on the shore of the south side of the Thames, the after part below Woolwich. From the wrecked state of these ends of the ill-fated vessel, our readers will be able to judge of the force of the collision, which, although it took place when both vessels are recorded to have been moving very slowly, was sufficiently terrible in its effects to have caused the propelling engines to drop out of her, and leave the tangled mass of pipes, paddle-wheels, steering chains, &c., as shown in the sketch. The paddle engines, which fell to the bottom of the river, when recovered showed, from the position of the levers, that the engineer was in the act of reversing them when the vessel was struck, and that one of them, in fact, had been already shifted, while the other remained at "go ahead."

The Board of Trade inquiry into the cause of the loss of the Princess Alice, the report of which did not appear till a couple of months after the event, resulted in the decision that her captain was alone to blame for the loss of the vessel, from his neglect of rules which he and every other steamboat captain on the Thames dis-

regarded daily, and all day long. Notwithstanding this decision, there remained no doubt whatever, that had the Princess Alice been made a much stronger vessel than she was—a mere bandbox as to structure—she would have kept above water long enough to have saved the greater part of her passengers from a terrible death.

From a constructive point of view, it was agreed by experts of wide experience that the vessel was utterly unfitted for the service she had to perform, and that she ought never to have been allowed to carry passengers at all on the Thames, as the great space occupied by her engines and boilers—60ft. to 70ft. in length—should have been devoted to increasing her buoyancy, this great length being only defended against the ingress of the water by plates barely $\frac{4}{10}$in. thick. With the actual buoyancy of the forward and the after ends of the vessel, and the dead weight of the machinery, boilers, and coals in the middle, it followed that if by any mischance this space was cut into, nothing could save the vessel from breaking in two, a result which actually befel this most unfortunate steamer. To those of our readers who take interest in the river steamboat question, we commend the perusal of an article which they will find in THE ENGINEER for November 15th, 1878.

No reasonable objection can be urged against the use of properly-designed and constructed steamboats on the Thames, but let all persons see to it that no vessel shall be permitted to carry on the transit of passengers on its waters, above or below bridge, without a sufficient assurance that it is so constructed as to secure the perfect safety of the lives of those who trust themselves on it.

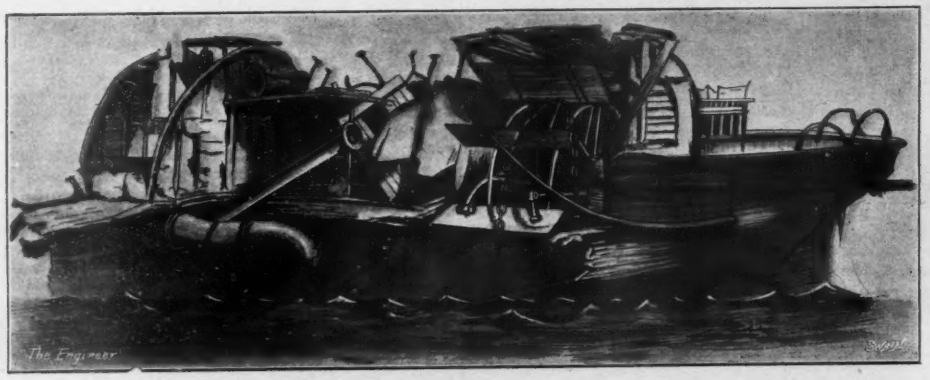


Fig. 6—PRINCESS ALICE—AFTER END

THE PROGRESS OF THE CONTINENTAL MERCHANT MARINE.

THERE was published in THE ENGINEER of the 11th May last, under the title of "The Progress of the German Mercantile Marine," an article dealing with the development of a large section of the shipping industry of Germany during 1899. Since then further information has become available in relation both to other Teutonic shipping companies and shipping enterprises in other parts of Europe, and to certain German shipbuilding firms. Unfortunately, except in the case of a comparatively few undertakings, it is impossible to obtain general information concerning the financial position of the other German shipbuilding companies, probably for the identical reason which prevails with certain large and leading engineering works in that country—namely, the desire to maintain absolute secrecy as a means of protection against inland and foreign competitors and political adversaries. It is, however, well known that the German shipbuilding industry is progressing, that several new private yards are either projected or in course of construction, and that the Government will very soon introduce legislative proposals for increasing the shipbuilding facilities at the State dockyards, in order to give effect to the comprehensive naval extension scheme which was adopted some months ago. These are, of course, questions for consideration in the future, but the important fact exists that at the present time Germany is so much engaged on home orders that her shipbuilders are not making that extent of progress with which they have been credited in some quarters, in so far as the construction of vessels for other nations is concerned. This will be obvious from the following figures, which refer to the vessels being built in German private yards for foreign account during 1898 and 1899, and which have been issued with official *imprimatur* in Germany:—

Type.	Year.	No.	Tonnage.
War vessels	1898	34	32,576
" "	1899	23	16,143
Merchant vessels	1898	39	51,524
" "	1899	69	54,812
River vessels	1898	11	1711
" "	1899	33	2118

It will be seen that in 1898 foreign orders were responsible for 84 ships of 85,811 tons under construction, as compared with 125 vessels of 83,073 tons in 1899. These figures are instructive in so far as they show that although a larger number of ships was being built in 1899, the actual tonnage diminished by no less than 2738 tons. Yet the German papers, in commenting upon the matter, state that the figures prove that German shipbuilding can not only maintain its position in the international market, but also that it even constantly gains ground. Having disposed of this fallacy, it may now be interesting to give the further information which has been obtained, and which has been brought down to the date of the present time, as far as possible.

The Compagnie Générale Transatlantique, which will be recollected as being engaged both in the passenger and freight traffic between France and America, is largely subsidised by the French Government, although not on all the routes covered by the company's fleet. This will be understood from the fact that of the total distance steamed during 1899, 494,307 knots were travelled on subsidised lines and 197,067 knots in free service. The income derived by the company for 1899 amounted to £1,980,000, being £84,700 in excess of [illegible] earned in the preceding year, but as the expenditure largely increased, especially in the case of coal, the net profits developing its scope of activity during 1899, notwithstanding certain unfavourable events in that period. It appears that after meeting all heads of expenditure, including what would seem to be an ample margin for depreciation of the fleet, the net result is a profit of 521,355 florins, as compared with 514,287 florins in 1898. This sum has allowed of the payment, after satisfying the interest on the priority capital, of a dividend of 20 florins per share (3$\frac{1}{7}$ per cent.) on the ordinary capital, or at the same rate as in the previous year, whilst a larger balance has been carried forward to the next account. It is noteworthy that the deficit which arose in the years 1889-1891 is gradually being wiped out, there now being only about £110,000 to be written off under this heading. During the year three old steamers were discarded and four new vessels placed in the service, and the fleet at the close of the year numbered sixty-five steamers. As to the various services rendered by the company it may be mentioned that the traffic in the Adriatic Sea was of a normal character; but the lines to the Levant and the Black Sea yielded less satisfactory results in consequence of the unfavourable harvest, and the Alexandria service also suffered through the enforcement of quarantine regulations. The company's report further states that owing to the special Customs dues less sugar was conveyed to India, but the deficiency in this respect was compensated by the increased exports to Japan. There was a large extension in the transport of corn and coffee in connection with the service to Brazil. An echo of the Welsh coal trade is found in the statement that in consequence of the extremely high prices demanded for Cardiff coal the company was compelled to obtain several shiploads of fuel from the United States; in fact, the price of coal was mainly responsible for the increase in working expenses during the twelve months. It was necessary to counteract this effect by increasing freights and by making further advances in the rates during the present year The business has made further progress during the early months of 1900, and in June the sanction of the Government was sought to raise additional preference capital amounting to 3,000,000fl. for the purpose of increasing the shipping accommodation at Trieste. In addition to this the company recently entered into an agreement with the Government to undertake a regular steamship service to Calcutta early next year, and it is also intended to establish a line of steamers to the East of Africa, the Government having agreed to grant a subsidy in each case, apart from the subventions already received from the State.

The Donau Dampfschifffahrt Gesellschaft, of Vienna, is fortunate in possessing auxiliary branches in addition to the general shipping trade conducted on the Danube. At present the company owns a fleet of 149 paddle-steamers, 42 screw steamers, and several hundred smaller craft for handling the traffic on the river. The income from the shipping traffic for 1899 was considerably less than in the previous year in consequence of the complete failure of the harvest in the countries situated on the Lower Danube, the diminution in the tug traffic, the low rates of freight, and the keen competition of the Russian Black Sea shipping enterprises, and the fleet worked as a monopoly on behalf of the Roumanian Government. The final result for 1899 was a deficit of 262,006fl. as compared with a net profit of 272,076fl. in the previous year. Turning to the auxiliary industries, it will be found that the operation of the Funfkirchen coal mines and the Mohacs-Funfkirchen Railway, together with the amount received as a Government subsidy, produced a net profit of 466,091fl., as compared with 972,220fl. in 1898. This allows on these branches of the payment of a dividend of 8fl. per share as against 16fl. in the preceding twelve months. The company is indebted to the Government to the extent of 1,585,921fl., of which the sum of 116,765fl. was added last year. It is understood that on certain conditions the Government is prepared to grant a subsidy of 600,000fl. per annum on behalf of the shipping undertaking, and negotiations to this effect are now proceeding.

La Veloce, the Italian shipping company of Genoa, does not appear to have had a happy record in recent years. At the close of 1898 there was a total balance against the company which exceeded £78,000, and the operations during the following year resulted in a further loss on trading account which increased the aggregate deficit to nearly £86,000. It is scarcely possible to ascertain correctly the exact causes which have led to the accumulation of a heavy adverse balance of this character, but it is satisfactory to find that the directors of the company are endeavouring to improve the position of the undertaking by a policy of retrenchment and reform. In the first place, the services which have proved unremunerative in the past have been relinquished, whilst on the other routes it has been possible to conclude each individual journey at a profit. The traffic with the Argentine Republic and Brazil has been satisfactorily developed, but the service to Central America has suffered in consequence of the reduced freights. Having redeemed the mortgage debt on the enterprise it is the intention of the administrators of the company to propose a reduction of the share capital to the actual value at which the fleet is estimated, and to provide for the extinction of the outstanding deficit to which reference has already been made. For the present, however, any definite action has not been taken to give effect to the proposed re-organisation of the financial position of the enterprise. This may perhaps be due to the fact that for the completed portion of the present year the working results have been more satisfactory than in 1899, but even this cannot long defer the placing of the enterprise on a sounder financial basis. In the meantime it is to be noted that the company has renewed its freight agreements with all the Italian, French, and Spanish companies interested in the service to the Argentine Republic.

The Nederland Steamship Company, of Amsterdam, appears to be in an exceedingly prosperous condition, although the working results for 1899 were less favourable than in the previous year. This position of affairs has been brought about by an increase in expenditure due to the rise in coal values and the advance in the price of all kinds of shipbuilding materials, by the less active employment of the freight steamers, and by a heavy loss through peculation. Notwithstanding these adverse circumstances, the gross profits reached a total of 1,977,000fl., as compared with 2,280,000fl. in 1898, and the dividend paid attains the respectable figure of 13$\frac{1}{10}$ per cent., as against 14 per cent. declared in the previous year. This satisfactory distribution has been made on a capital of 7,000,000fl., after having made provision for depreciation and reserve fund. During the present year the capital has been increased to 10,000,000fl., so as to provide for the further development of the enterprise.

The Flensburger Schiffsbau Gesellschaft, of Flensburg, is one of the oldest, and at the same time most prosperous, shipbuilding and engineering undertakings of its kind. A few months ago, when the share capital amounted to £65,000, it was decided to increase it to £165,000, and the new issue has since been offered at a premium of no less than 65 per cent. The possibility of obtaining such a high premium will be understood from the fact that the average dividend paid during the twenty-four working years of the company's existence amounts to 9$\frac{1}{2}$ per cent., the distributions in recent years having been 10 per cent., 8 per cent., 13 per cent., 18 per cent. in 1898, and 18 per cent. in 1899. During last year the company constructed nine new vessels of 27,899 gross registered tons, as compared with eleven ships and 27,501 tons respectively in 1898. The machine department of the company's works provided the complete boiler and engine equipment for six steamers, and it was also entrusted with the renewal of the boilers of several other vessels. The extent of business transacted may be gathered from the fact that the turnover reached a total of £330,000. During the present year nine steamers have been, or are being, completed, and the orders received for eight others will provide employment for some time to come. As to the question of further extending the company's operations, it is to be noted that work on the new shipbuilding yard, which was decided upon some time ago, has already been commenced.

The Bremer Vulkan, Schiffbau und Maschinenfabrik, of Vegesack, has a remarkably good record since the foundation of the company in 1893 with the modest capital of £15,000, for the purpose of shipbuilding and machine construction. The capital was soon advanced to £25,000; in March last it was increased to £150,000, and a further issue of £50,000 has recently been made. The company has paid two dividends of 10 per cent. each and two of 12 per cent., whilst for the present year the profits will be divided over a capital of £175,000. During the course of the present year the company has delivered one steamer of 1350 tons and a second of 7000 tons, and two steamers of 1000 tons; one of 7000 tons, and a large tug are practically completed, making a total tonnage of 17,000, as compared with 12,000 tons in 1899. The orders received for next year represent a tonnage of 18,100, whilst considerable bookings have already been made for 1902. It may be mentioned that a newly-elected member of the Council of Supervision is Herr G. Plate, of the North German Lloyd.

The Alster Company, of Hamburg, forms one of a number of similar companies which have been constituted locally during recent years for the purpose of participating in the increasing transmarine freight service due to the great development of the German export trade *vid* Hamburg, and as a consequence rates have been tolerably high, and appear to have yielded satisfactory results from this indefinite method of chartering the vessels. Closely associated with the well-known shipping firm of Sloman, of Hamburg, the company's original capital of £20,000 on the establishment of the enterprise in 1898 was speedily advanced to £62,500, which it has since been decided to increase to £125,000. The fleet only consists of five sailing vessels, although a steamer was to have been added last month, and the profits realised for 1899 are stated to have allowed of the payment of a dividend at the rate of 8$\frac{1}{2}$ per cent. The further issue of capital mentioned was recently offered for subscription, but the prospectus did not contain any indication of the routes traversed by the vessels.

The Rhederei Actien Gesellschaft von 1896, of Hamburg, which was formed in the year indicated in its title, is another undertaking of somewhat unimportant pretensions. In 1897 the company paid a dividend of 6$\frac{1}{2}$ per cent. on a share capital of £15,000, in 1898 7$\frac{1}{2}$ per cent. on £25,000, and in 1899 8 per cent. on £50,000. Further issues of shares, so as to bring the total capital up to £125,000, have been, or are being, negotiated for the purpose of increasing the fleet. At present the company owns six sailing vessels of 17,200 tons, four having been purchased in England and two in Germany. The vessels are not engaged on any specified routes, but generally travel with cargoes for South American ports, the return freights mostly consisting of saltpetre.

RAILWAY MATTERS.

A FURTHER single-wheel express locomotive for the Great Central Railway, making five in all, has been turned out from the Gorton works.

THE conductor rail used in the electric traction equipment of the Manhattan Elevated Railroad, New York, now being converted, is of 100 lb. section, in 60ft. lengths, mounted on vitrified clay insulators.

. A CONCESSION has been granted to run a line of underground tramways, by electricity, between two of the stations in Buenos Ayres situated at its extreme points, also to run various other lines in and about the city.

THE Waterford and Tramore Railway in the South-East of Ireland is a single line on the standard Irish gauge of 5ft. 3in. It is 7¼ miles long, and was opened in 1853. This line is entirely isolated from every other railway, and is over a mile distant from any other station in Waterford.

ACCORDING to a notice recently issued in St. Petersburg, the Russian Minister of Ways of Communication, with the object of accelerating the transport of goods over the Russian railway systems, has decided to provide all the State railways with express locomotives from the beginning of next year.

THE total length of all railways in Japan on March 31st was 3635 miles 42 chains, of which 832 miles 78 chains belong to the Government and 2802 miles 49 chains to private companies, showing increases of 64 miles in Government railways and 159 miles in private railways, a total of 223 miles compared with the figures of the preceding fiscal year.

THE Chicago and Alton Railroad has changed all its fixed signal lamps so that green is the indication for all clear at night on such signals throughout the company's lines. Red glass has been adopted for the stop indication in all home signals and yellow for distant signals. The total number of fixed signals on the lines of the company, exclusive of switch lights, is 423.

ACCORDING to the New York *Engineering News*, the Municipal Council of Kertch, in the Russian province of Yenikale is willing to grant a concession for an electric tramway. This city, of about 50,000 inhabitants, is being greatly extended by the construction of blast furnaces and the development of iron mines. A railway from Theodosia to Kertch is now under construction.

SINCE July 1st last the Illinois Central Railroad has added 100 locomotives and 2500 cars to its equipment, and has built 84 miles of additional second track. A further 80 miles of line is to be completed next year. The company has recently contracted for a further supply of 500 cars of 50 tons capacity, and 1000 of 40 tons capacity, and is also building 500 of the latter size at its own shops.

THERE was an increase last year in the value of the import into Nagasaki of railway carriages and of materials for their construction, amounting to £14,304 in 1899. Of the total import, the value of passenger carriages and materials for their construction amounted to £12,953, all of which were obtained from England, while that of freight wagons and materials was £11,843, of which the value of those from England was £5787, from Germany £2221, and from the United States £3072.

Two hundred tramway cars, operated by compressed air, have recently been added to the air-working plant in New York; and although the conditions there are exacting, the cars making frequent stops by reason of the many tracks and narrow streets, and also by stopping at any point to pick up passengers, the service is said to be good. In Chicago air cars have been performing night service for the past sixteen months. There is no noise from the machinery except at starting, when a slight exhaust is noticeable.

AN electrical plant has been installed in the locomotive works of the Austro-Hungarian State Railroad Company at Vienna. There will be a three-phase generator of 300 kilowatts, direct-connected to a compound-condensing steam engine. The generator makes 125 revolutions a minute at 200-volt tension. For repair work or minor working purposes a generator of 60 horse-power has been provided. To begin with forty motors of ½ to 30 horse-power will be installed, with a total capacity of 400 horse-power. The machines in the machine shops, boiler shops, foundries, carpenter shops, and erecting shops will all be driven by electricity.

AN improved exhaust pipe for locomotives invented by Mr. J. Jones, the locomotive superintendent at the Cyfarthfa Collieries in South Wales has been used successfully for some time. It consists of a cast iron exhaust pipe provided with a perforated semicircular jacket which commences just above the lower flange and terminates in a circular nozzle slightly above the top edge of the inner pipe. There is a tendency to form a vacuum within this jacket by the efflux of exhaust steam from the combined nozzles, and it thus becomes a regulator for ensuring an equal exhaustion of the smoke-box, and consequently a uniform draught through the boiler tubes. The action also obviates the emission of sparks.

A NEW shunting pole has been recently experimented in some busy yards in London. It consists of a pole to which is attached an electric lamp and battery. It is of the ordinary length, and only 1 lb. heavier than those in use in the marshalling yards at the present time. The battery is enclosed in a cylindrical chamber at the butt end of the pole, which is attached to the wooden part, and completes the length of the pole. The part of the iron hook which is attached to the opposite end of the wooden portion of the pole is hollow at the extremity, and in this hollow space a small electric lamp is placed. By the pressure of a spring at the butt end, the current is applied. At each side of the lamp, in the hollow hook, there is a small oval glass, with windows of the "bull's eye" description, one red and the other green, representing "danger" and "clear" respectively.

THE water used by the locomotives on the Southern of Austria Railway has a total hardness of 44·64 English degrees. Its analysis shows 13·72 grains of lime per gallon, 8·61 grains of magnesia, and 13·02 grains per gallon. Before use the water is treated by the Beranger and Stingl process, the reagents used being milk of lime and soda, with subsequent filtration. At Vienna about 66,000 gallons are purified in from 13 to 14 hours. The apparatus consists of two reagent tanks, each of 8800 gallons capacity, from which the reagent is pumped into a small mixing chamber of 880 gallons capacity, and from thence through a larger mixing chamber—1320 gallons—into five cylindrical filters of 2200 to 3300 gallons capacity, the purified water being stored in two tanks, each of 19,800 gallons. The process costs 3·6d. per 1000 gallons, and the hardness is reduced to 11·7 degrees.

SEVERAL important new railways are projected in the Don Valley, Yorkshire. The Hull, Barnsley, and West Riding Junction Railway is asking Parliament for powers to considerably extend its undertaking. A new line is to be laid from Thurnscoe to Denaby, passing through the parishes of Adwick, Barmborough, and Mexborough; another from Denaby to Rotherham, passing through Hooton Roberts, Thrybergh, and Dalton; and another from Denaby to Maltby, passing through Conisborough, indissolubly associated with Sir Walter Scott's "Ivanhoe," Hooton Roberts, Braithwell, and Bramley. The two first lines are a continuation of the policy of the directors to run trains from Hull straight to Sheffield. Included in the same application is a further proposal to make a junction with the Midland Railway Derby to Leeds line at Kilnhurst. There will also be a junction with the Roundwood and Dalton Colliery Railway, and with the river-road siding of the Aldwarke Main Colliery on the south-eastern side of the Great Central Railway.

NOTES AND MEMORANDA.

THERE are at present in Germany no less than thirty-two small towns lighted by acetylene gas, or in which this illuminant is being installed, and many more are contemplating its adoption. The progress of acetylene lighting in Germany is remarkable.

THE shipbuilding returns for the year are approaching completion. The output for the Tyne, including battleships, is in round figures 297,000 tons, against 308,000 last year. For the North-eastern ports, comprising the Tyne, Wear, West Hartlepool, Tees, Whitby, and Blyth, the aggregate is 870,000 tons, against 880,000.

THE exports of india-rubber from French Guinea have largely increased since 1891, the amount exported in that year being 829,000 kilos.; in 1892, 952,000 kilos.; in 1893, 996,466 kilos.; in 1894, 996,000 kilos.; in 1895, 947,000 kilos.; in 1896, 951,000 kilos.; in 1897, 1,399,000 kilos.; in 1898, 1,693,000 kilos.; and in 1899, 1,857,130 kilos., or nearly 2000 tons.

THE production of mineral oil in India, which is confined to Burma and Assam, amounted to 33 million gallons in 1899, about 32½ million gallons being of Burman production. Up to the present the production supplies Indian requirements to but a small extent, these being met by the importation of some 79 million gallons from the United States, Russia, and Sumatra.

THE exploitation of the Michigan coal basin is proceeding very successfully. While comparatively limited in area, and not of sufficient extent to compete at any distance with the coal of Ohio or West Virginia, the Michigan mines have a large local coal market which they can well supply. The somewhat greater cost of mining is balanced by the cost of transportation from other fields.

EXPERIMENTS recently carried out in America serve to show that the corrosion of soft steel and wrought iron is materially reduced by the addition of a small percentage of copper, not sufficient to effect prejudicially its physical qualities or its mechanical production. In soft Bessemer steel it was found that that the addition of from 0·078 to 0·263 per cent. of copper diminished the corrosion.

WITH regard to the capacity of batteries for electrically-propelled motor cars, *l'Electricien* remarks "that it is usual to adopt a battery consisting of forty-four elements, which gives an available mean difference of potential at the terminals of about 85 volts. The mean output of energy per ton-mile of a well-constructed car is about 136 watt-hours, whence it follows that an average output of 1·60 ampère hours per ton-mile may be relied upon."

THE imports of coal into China in 1899 amounted to 859,370 tons. Of this amount, 610,564 tons went through the port of Shanghai. The imports in 1898 were 780,606 tons, thus showing an increase for 1899 of 128,764 tons. The quantity of Chinese coal produced was probably not over 500,000 tons in 1899, and of this amount 112,245 tons of Kaiping coal were brought to Shanghai. Most of the coal used in the coasting trade and foreign steamers is Japanese.

THE total yearly output of coal from all the mines in Japan is now estimated at not less than 4,000,000 tons. Over three-fourths of this is produced in the island of Kiusiu, the Takashima mines in the immediate neighbourhood of Nagasaki, from which comes the highest quality of all Japanese coal, contributing 200,000 tons; the Miike mines, five in number, which rank next in reputation for quality to that of Takashima, and produce a most excellent coal, both for steaming and gas purposes, contribute nearly 800,000 tons.

AN electrically-propelled lorry is in use by a sugar refiner, M. Say, in Paris, to carry loads of refined sugar between his manufactory and the different stations of the various railways of the capital. This lorry weighs 11·8 tons with the accumulators, and carries 10·0 tons of sugar. The motor is 20 horse-power. In the runs which it made during the recent trials at Vincennes, it reached a commercial speed of 3·3 miles an hour. It mounted the hill of Corbeaux, which has a gradient of 10 per cent., at a mean speed of 2·0 miles an hour, taking a current of 200 ampères at 155 volts.

NOT content with producing carbide in Germany, German capital has gone to Norway and Switzerland, and carbide works have been erected which are managed by German engineers. About 80,000 horse-power has been acquired for this purpose in Norway alone. One of the greatest successes of the acetylene industry has been the adoption of the acetylene oil-gas system of lighting railway carriages by the Prussian and other German Governments. The Prussian railways consumed in 1898 about 960 tons of carbide, in 1899 about 5000 tons, the total consumption for all German railways being about 8000 tons.

A SERIOUS trouble with incandescent mantle gas lighting is the carbonisation of the mantle, which commences with a slight sooty deposit at one spot, and then rapidly grows over the surface of the mantle, not only reducing the light emitted but giving rise to traces of carbon monoxide in the products of combustion. When the flame is under aërated and contains a ratio of less than 2·2 volumes of air to 1 of gas, according to Professor Vivian B. Lewes, some methane escapes combustion in the inner zone of the flame and burns with the carbon monoxide and hydrogen in the outer flame, and it is this which causes the trouble.

FORTY-EIGHT fresh trade disputes occurred in November, involving 18,099 workpeople. During November, 137,738 workpeople obtained advances averaging 6½d. weekly per head, and 11,036 sustained decreases averaging 1s. 7d. weekly per head. The principal increases were in the coal-mining industry in South Wales and Monmouthshire, affecting 125,000 workpeople; in the iron and steel trades in the North of England, affecting 5450 workpeople; and in the felt hat trade in Lancashire and Cheshire, 2798 workpeople. The principal decreases affected 5000 coal miners in the Forest of Dean, and 6000 iron and steel workers in Scotland.

THE production of gold in Russia during 1898 was about 1,236,000 ounces. It may not be generally known that all the precious metal has to go through the Imperial laboratories of Ekaterinburg, Tomsk, and Irkutch, whence it is despatched to the mint at St. Petersburg, so that hitherto there has been no free choice in the sale or price. Alluvial river gold of the most varied description, forming about 93 per cent. of the total yield, is found in the basins of the Obi, Yenisei, Lena, Olekma, Vitim, and Amur, and, in fact, in every government of Siberia, the auriferous sand generally being covered with a layer of earth and peat. Gold is found extensively in the north-west parts of the Altai Range, in the Nerchinsk district, in the Trans-Baikal, and Eastern Siberia generally.

ACCORDING to the Board of Trade report on trade unions in the United Kingdom issued recently, the number of unions on the list at the end of 1899 was 1292, which compares with 1218 at the end of 1892. The membership of all the unions at the end of 1899 was 1,802,518, as compared with 1,503,232 at the end of 1892, an increase of 20 per cent. in the eight years. During 1899 the total number of trade unions decreased from 1310 to 1292. This decline of 18 is due to amalgamation of that number of smaller unions with larger organisations, the number of unions (30) formed during the year being the same as the number dissolved. The total membership, however, of the trade unions rose during the year from 1,649,231 to 1,802,518, an increase of 153,287, or 9 per cent.

MISCELLANEA.

A NEW calcium carbide factory has been erected in Meraker, in the north of Trondhjem, says the Consul-General at Christiania. It is constructed to yield some 2500 tons of carbide per annum, and will employ about ninety hands. The produce will be shipped from Hommeloig and Trondhjem.

THE German Consul in Payta-Piara (Peru) reports the discovery of large rubber forests on the Niera River, a branch of the Amazon, which can be reached from the middle of the tobacco plantations by an eight days' journey. Several German firms organised a large expedition to start for the interior and to secure the rights to collect the rubber. As the natives are very poor, it is expected that cheap native labour will facilitate the collection.

NEW records are established every season in carrying iron ore on Lake Superior. The latest big cargo reported was taken down by the steamer Maricopa and two barges for the Minnesota Iron Company. The barges were towed by the steamer, and the three vessels together carried 22,635 tons of iron ore, which is claimed to be the greatest quantity ever moved on Lake Superior by a single engine. The average speed made by the tow was 11 miles an hour.

IT will be somewhat startling news to most people in this country to know that Bengal pig iron is being sold, on equal terms with Middlesbrough iron, in Sydney and in Melbourne, in Hongkong, and in Shanghai, says the *Iron and Coal Trades Review*. Yet such is the case, and it is said that the Bengal iron is much liked and has "come to stay." To the Bengal Iron and Steel Company, Limited, belongs the credit of such enterprise. The company is of English origin.

THE county borough of Stockport is about to appeal to Parliament for a Bill empowering the Corporation to construct reservoirs, conduits, and other works for impounding, using, and distributing within the limits of water supply of the Corporation the waters of the rivers Sett and Kinder and their tributaries, and other waters to be intercepted or taken by the intended works. The total cost of the scheme is £685,710. The work will be divided into three sections, and the cost will be spread over twenty-six years.

LAST year's export of gold from Corea showed an increase of £55,765. The American mines in the district of Woonsan are now in full working order. German mines are in the process of development, and a British syndicate is now in possession of the Unsan gold mines, probably the richest in the country. The gold-bearing strata is a sedimentary deposit of large area, similar in many respects to the deposits on Witwatersrand. To prevent confusion with the American mines at Woonsan, the name of the Unsan district has been changed to Gwendoline.

THE municipal electric light and power station at Stockton was formally opened last week. The three-wire system has been adopted with 460 volts between the outer conductors, the standard pressure of supply to the consumers being 260 volts. The generating machinery now installed consists of three "Universal" engines coupled to the Brush Company's standard type of continuous-current generators. The dynamos are controlled by automatic switches and also by fuses which will prevent damage being done by an excessive current.

IT was decided at a congress of the representatives of industry recently held in Vienna to petition the Government to prevent the price of coal from rising in such a manner as to injure seriously the country's industry. The Government is requested to abolish the monopoly of mine-owners and large dealers by encouraging the opening of new mines in many parts, especially of Bohemia, where coal is known to be plentiful, by not renewing or prolonging the contracts of Government mines with dealers, and by reducing the railway tariffs for coal imported from foreign countries.

Two large sugar refineries have been established in Japan, at Osaka and Tokyo, capable of turning out in the aggregate about 80 tons of refined sugar per diem, and both have financially been so eminently successful as warmly to encourage the continued development of this industry in Japan, under prospects that every year are more and more brightening. The establishment of a third refinery on a large scale is being promoted at Wakamatsu, close to the rising port of Moji in the north-west of the island of Kiusiu, a locality which is in every sense most favourably situated for the industry.

ONE of the firms devoted to the manufacture of steam motor carriages in America has offered a steam carriage, free of expense, to the U.S. War Department. It is guaranteed that the vehicle will carry 1000 rounds of ammunition, four riflemen, four rifles, two entrenching shovels, food for the four men sufficient for three days, four pairs of blankets, two rubber shelters reaching down from the sides of the car, and sufficient fuel for a run of 200 miles. The guarantee further provides that the car shall be able to travel 100 miles between sunrise and sunset, over average American country roads or even the unbroken prairies of Colorado.

AT a meeting of the shareholders in Marconi's Wireless Telegraph Company held last week, the Chairman stated that the company had completed the whole of the thirty-two sets of apparatus ordered for the Admiralty, and the captain of her Majesty's ship Vernon, under whose supervision the work was done, had expressed himself satisfied with the manner and expedition in which everything was carried out. He afterwards referred to improvements in the system on which Mr. Marconi was engaged, and said that they were of an important character. It was hoped that it would be possible to submit the improvements to the inspection of the Admiralty officials next month.

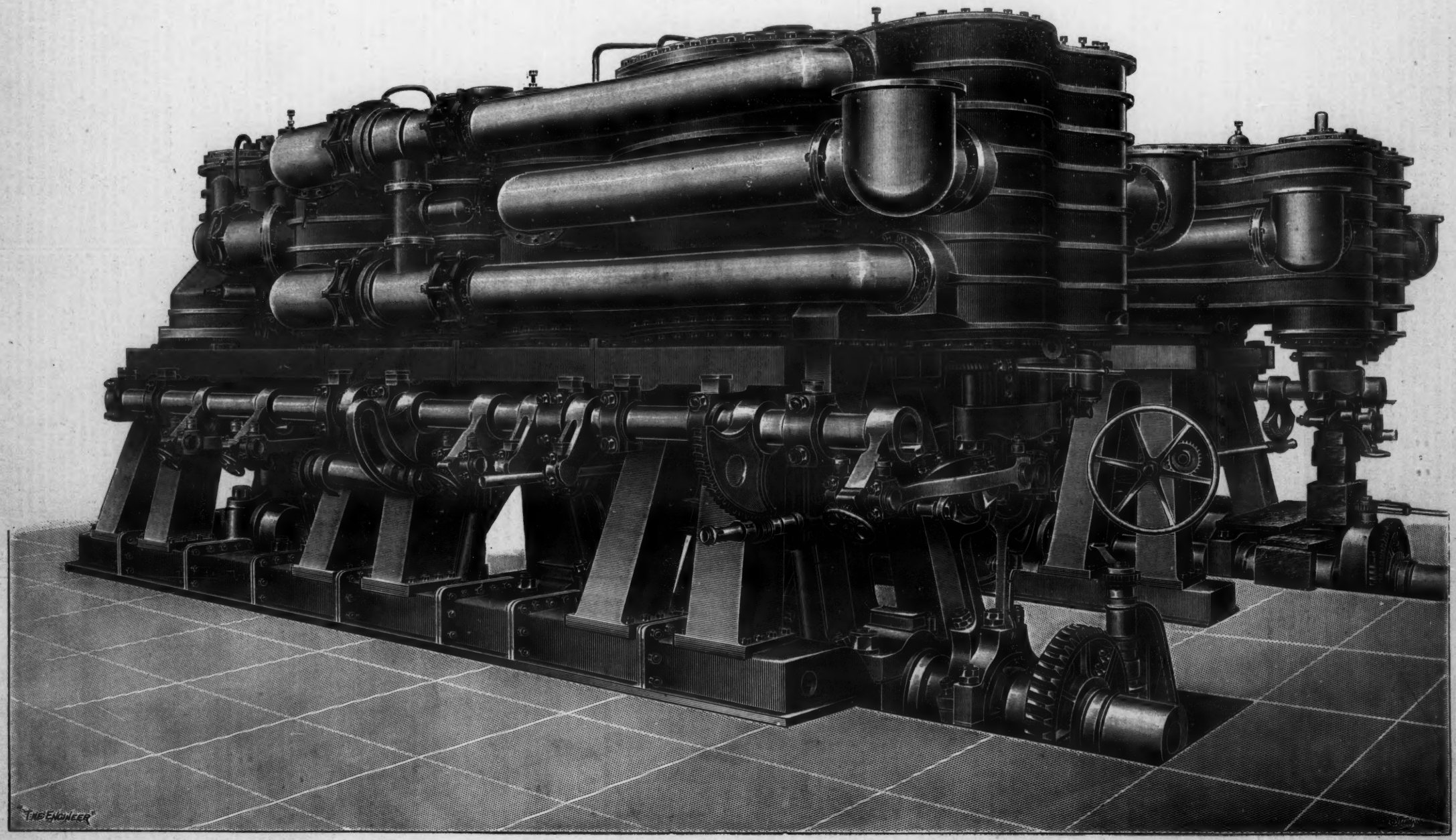
LAST week a conference took place at Birmingham between representatives of Worcester, Gloucester, Cardiff, and other towns situated in the neighbourhood of the river Severn and Bristol Channel, to consider a scheme for improving communication between Birmingham, the Black Country, and the sea. Several speakers urged Birmingham to join in a scheme for widening and deepening the Severn and existing canals, to allow vessels of 200 tons to proceed from Gloucester to Birmingham without unloading, pointing out the enormous saving in time and freight which would result. On behalf of Birmingham it was stated that the City Council had fully considered the question of waterways, and exhaustive inquiries showed that the principal requirements were for improved communications with London and Liverpool, only small proportions of the Midland traffic going *viâ* the Bristol Channel ports.

IF it is really true, says the *Statist*, that Americans can construct bridges equal in every respect to those built by British competitors, and yet at a lower cost, it is time that our people should recognise the position into which they are rapidly drifting. If it be really true that partly because of the recent experience acquired in consequence of the immense amount of work given by American railway companies, partly because of the ingenuity of American business men in providing themselves with the best available machinery, and partly because, lastly, of cheaper coal and iron, American bridge builders can turn out work cheaper than, and equally as good as, that turned out by British competitors, it is remarkable that a greater rise in wages has not taken place in the United States already. It would almost look as if, in spite of the extraordinary prosperity of the past four years, the American home trade is not yet as well employed and as profitable as the home trade in this country. Let us add that the United States manufacturers have no Great George-street to handicap them.

ENGINES OF THE FRENCH CRUISER KLEBER

SCHNEIDER AND CO., CREUSOT, ENGINEERS

(*For description see page* 641)



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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.*

REPLIES.

D'TOM (Aburi).—We do not know of the use of the Fischer system in this country. It is, however, in operation at Worms, in Germany.

ERRATUM.

In our issue of the 14th inst., underneath indicator diagrams on page 589, for scales $\frac{1}{1\frac{1}{4}}$ and $\frac{1}{4}$ read $\frac{1}{1\frac{1}{2}}$ and $\frac{1}{2}$.

MEETINGS NEXT WEEK.

THE INSTITUTE OF SANITARY ENGINEERS (INCORPORATED).—Wednesday, January 2nd. Council Meeting at 7 p.m.

THE RÖNTGEN SOCIETY.—Thursday, January 3rd, at 8 p.m., at 20, Hanover-square. Paper, "Continental Progress in Practical Radiography and Apparatus," by Mr. A. W. Isenthal.

GEOLOGISTS' ASSOCIATION, LONDON.—Friday, January 4th, at 8 p.m. Paper, "The Geology of Swanage—Chapman's Pool to Punfield Cove (Kimeridge Clay to Upper Greensand)," by Mr. Horace W. Monckton, V.P.G.S.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, January 1st, Thursday, January 3rd, Saturday, January 5th, at 3 p.m. Afternoon Lectures on "Great Chapters from the Book of Nature," by Sir Robert Stawell Ball, D.Sc., LL.D., F.R.S.

THE ENGINEER.

DECEMBER 28, 1900.

EDUCATION AND TRADE.

MUCH has been said recently about the decline of British trade, and much advice has been given as to the means of checking its downward course, and even of reinstating it in its old position. No method of achieving these desirable ends is more popular than that which advocates an extension of scientific education. A lack of technical training is, we are told, at the root of our decline. Ignorance is, we are given to understand, the frost which is killing our commerce, whilst the genial rays of knowledge are causing the trade and progress of Germany and America to increase a thousandfold. The scientific technical education of the Germans, and the scientifically-fostered acuteness of the Americans, are used alternately as a goad and a guide to the sluggish conservatism of British manufacturers. It is well, of course, that we in this country should be kept alive to the necessity for unsleeping vigilance in the pursuit of business. But it is no less important that we should see things as they are, and not lose our heads and our dignity by blindly and unintelligently accepting hysterical statements. It would be well, indeed, to investigate critically all such assertions as are made, and to inquire if the means suggested for improvement are likely to be sufficient. For example, it is very generally stated, and almost as readily accepted, that the superior technical and scientific training of German workmen is leading to their acquiring, to our detriment, much valuable trade. May we ask where the authority for that assertion is to be found? May we ask for concrete cases of the loss of an English market from this reason? May we ask for statistics of the occupations, salaries, and general positions of these scientifically-trained Germans? We dare not doubt that they exist, they have been so thundered into us by those who speak in authority; but, for our own enlightenment and for that of our readers, we would feel grateful to some of those who apparently know so well, if they would adopt a scientific plan themselves, and show us by x, y, and z that the root of German progress is technical education. We ask especially for particulars applicable to mechanical and civil engineering. We believe that to nearly everyone who ponders on this request the first thought will be of aniline dyes. What will the second thought be? Have they at hand a concrete case in mechanical or electrical engineering to show? We shall await an answer with interest. The case with America is somewhat different. We hear less of the superior education of the Americans, and yet at the present time they are more serious rivals than the Germans. We are told that the Americans are of superior intelligence to Englishmen. Again we venture to ask for specific information. We do not doubt the statement, but we want to have the fact on a scientific basis. We want to be shown that any given representative American workshop contains a greater number of intelligent employés than a British workshop of similar standing. In making this comparison, we would invite correspondents to make sure of the nationality of the men who constitute the greatest intelligence in the examples they cite. On the other side, we would invite our home statisticians to show us that the trade of Great Britain is departing from it. We do not want to be told that the trade of America or Germany is greater than it used to be; we want to be shown that ours is considerably less, and that it is declining, not only oscillating as the trade of all countries does. We want to be shown, moreover, that the further capacity of Great Britain for production is being used less rapidly than it used to be. We want to be shown that order books are empty, that shops are working half time, that many are in the market, and that little capital is being expended on new developments. All this we must have, not vaguely but certainly, before we can believe, as critical men should believe, that the trade of our country is in a bad way.

The greatest mistake that is made by critics of our trade is to compare it with America and Germany of a few years ago. To have maintained the relative position which we held some twenty years since, it would be necessary that our trade should have increased at an altogether incredible and impossible pace. For, let us suppose, for the sake of argument, that our trade was double that of America at that date, and that America's trade is now twenty times what it was then, to preserve our position our trade would have had to increase fortyfold. On the other hand, if we had only maintained our lead, there would now be only a very small difference between us. To do that we, a comparatively old country, would have had to progress at the same rate as a far younger country with unlimited possibilities and limitless area, suddenly awakened to a new existence. Was such a thing to be expected? The question is not whether Germany and America are improving their markets, but whether we can improve ours. To those who reap profit or pleasure from prophesying evil things we would say, Show us that Great Britain has not been working to its maximum capacity whilst others have been gaining a footing in our markets. Disprove the existence of new works, the enlargement of old, the betterment of method, the night and day labour. Demonstrate that order books are empty, that material is being made for stock, that proprietors are anxious and depressed. Trade is in all probability about to enter on a period of depression. That depression will be world-wide; it will not be peculiar to Great Britain, and it will pass from us when it passes from the other nations. We may even go so far as to say that it will be of direct benefit to this country. Already there is talk amongst the manufacturers of the opportunities of improved methods which the easiness in trade will give them the opportunity of introducing. In some branches of engineering, at any rate, we shall see Great Britain in a better position at the end of the period of depression than before it. Of that we feel assured. It may therefore be met without misgivings.

But when the revival comes again we must be prepared to make the most of it, and it behoves us to search diligently for the best way to do this. Improvement of the artisan will help, technical education will help, but more than anything our success will depend upon commercial astuteness. It is that, and that almost entirely, which has given America and Germany their success in late years. Their goods are not better than ours, but they know how to sell them; their knowledge is no greater, but they use it more wisely. Let us establish more and more schools of commercial training—schools where the art of selling will be taught, and the art of organisation will be a feature of the curriculum. It will be useless to be provided with splendid methods, with clever workmen and excellent tools, if we have not the means of inducing the markets to accept the goods we manufacture.

THE PREVENTION OF SMOKE.

THE fining of metropolitan steam users for causing a nuisance by sending smoke into the atmosphere, goes on merrily. Now it is an electric light station that offends; anon it is a dozen locomotives; and the defence is always the same, and is always useless. The magistrate has only to administer the law; and to tell him that smoke cannot be prevented is waste of breath. So the offenders pay their fines, and pray that it will be some little time before the energetic detective finds them again breaking the law. The story of the smoke nuisance is an old story. James Watt gave instructions as to firing, so that the evolution of smoke might be prevented; and took out a patent about 1776 for apparatus to prevent smoke. He advised that fresh coal should always go on at the front end of the grate, so that the gases given off might be burned by the live fuel further on in the furnace, and the advice was so good, although the theory of it is shaky, that it is put in practice to this day with excellent results. It seems a little strange that a host of inventors, a vast outlay of money, and no little real skill, should have left the problem of burning bituminous coal without smoke unsolved. It is, no doubt, necessary, or, at all events expedient to say here for the sake of self-preservation from infuriated inventors, that we do not ignore their claims, and that we admit that every one of them can burn coal without making any smoke; but we must, if we were to perish for it, add that this result can only be achieved under conditions which are not always present. Indeed, we may go so far as to say that certain smoke-burning devices are, as is well known to the inventors of other smoke-burning devices, efficient only under conditions which would secure immunity from smoke in any case. Thus, for example, given ample boiler power and reasonably good coal, and it will be the fireman's fault if any smoke is made worth fining, a perforated fire-door sufficing to prevent it. When boilers are too small for their work, and hard driven, and furnaces are contracted in dimensions, we have all the conditions essential to giving the smoke-preventing inventor a good chance to show what he can do. The result is too often extremely disappointing.

Why is it that certain coals give off torrents of smoke, and others give off none, or next to none? The glib answer is that bituminous coals smoke for lack of air. Why do they smoke for lack of air? The usual answer is that the smoke is due to imperfect combustion, which answer seems to be the first lap in a circular course of question and answer, in which neither ever wins. The grand panacea is air, and as this is known to be useless if admitted in lumps, so to speak, we find that the greater number of smoke preventers are in reality nothing but colanders, or sieves, with which to divide the air into streams; or else steam spray mills, with which to grind it very fine and scatter it through incipient flames. But, after all, we have not got to the root of the matter, and no one ever has got to the root of the matter, save, perhaps, some "mute, inglorious" chemist, who has arrived at the facts, but does not see how to apply

them. Let us try to present the problem in a slightly novel way to our readers.

Good North-country smoking coal consists of carbon, 82·12 per cent.; hydrogen, 5·31 per cent.; nitrogen, 1·35 per cent.; sulphur, 1·24 per cent.; oxygen, 5·69 per cent.; ash, 3·77 per cent. This is the average of eighteen samples. Compare this with Llangennech, a very fine Welsh steam coal, nearly smokeless: Carbon, 84·97 per cent.; hydrogen, 4·26 per cent.; nitrogen, 1·45 per cent.; sulphur, ·42 per cent.; oxygen, 3·50 per cent.; ash, 5·40 per cent. Does this statement of the composition of the two classes of coal give us any clue to why one is smoky and the other is not? Curiously enough hydrogen, the greatest heat producer known, which burns absolutely without smoke, is more plentiful in the North-country than it is in the Welsh coal; oxygen the same. Anyone who had not experience would, if asked, say, from an examination of these figures, that the North-country would be the smokeless coal, which is directly contrary to the fact. Next let us ask ourselves what is the smoke that creates a nuisance. The reply is that it is a very small quantity of the fuel put on the grate bars in the form of an extremely fine dust; or, in short, an almost impalpable powder. The quantity is so small, and the division so minute, that a few pounds of it will suffice to leave the trail of a steamer some miles long at sea on a still day. The prevention of the smoke nuisance resolves itself, then, into preventing this fine dust from escaping up the chimney. Concerning sulphurous acid, and carbonic oxide, and carbonic acid, we need say nothing. They are invisible, and do not come within the purview of the law, albeit they do mischief, while the coal dust or soot is practically innocuous as compared with the more or less poisonous gases which we have named. CO is, indeed, a most deadly poison to animals, as is sulphurous acid to plants. Now, why does the combustion of North-country, or bituminous coal, set this dust floating in the furnace, while Welsh coal can be burned without producing it? We confess that we do not know; and we feel the less self-abasement in making this confession, that we firmly believe that no one else does. There is a general theory afloat that smoke is a chemical compound. For the purpose of the law, at all events, it is nothing of the kind. It is a compound of hot air, and numerous other wholly invisible gases, in which is suspended an extremely fine black dust. In the smoke there are also water vapour, and certain volatile hydrocarbons in the nature of greases or oils, which impart to this soot a peculiarly disagreeable character. There is also ammonia; but with these concomitants we need not trouble ourselves. The ammonia and the grease vapours and such like are all invisible. The one thing to be got rid of at first, or at last, is the carbon dust. It is for the evolution of this, and this only, that the magistrate inflicts fines. To argue to the contrary is to assert that gas may be visible, which is to uproot the foundations of belief, and not to be tolerated for a moment.

Proceeding a little farther, we come on facts which are curious or even startling when we turn their right side up for the first time. A prolific source of danger in coal mines and flour mills is dust. The stive of a flour mill explodes like gunpowder. Most disastrous explosions of coal dust have taken place in mines. In fact, it is generally taken for granted that when an oxidisable substance is in the state of fine powder the whole surface presented to the air is so large as compared with the weight that combustion will take place with the least provocation. Lamp-black, for example, is a dangerous commodity, liable to spontaneous ignition. Steel filings burn freely when sprinkled through a flame, while gunpowder will not ignite, and so on. How does it come to pass, then, that the carbon dust of smoke escapes? Under any circumstances, just under the brick arch in a locomotive is a fairly hot place; why does not the "black" of the smoke ignite there? The general answer is because there is not enough oxygen present; but something more than this is wanted by way of explanation, because, as a rule, there is at least twice as much air passed through a furnace as is needed to secure complete combustion. The carbon particles or atoms must be heated to, at all events, a bright red heat before they escape. They are then in an excellent position for complete resolution into carbonic acid or oxide. Yet they pass away entire, and float off in the atmosphere, and induce magistrates to inflict fines.

Going back a little, we think it may be said that all the facts point one way, and that is to tell us that, prevention being better than cure, steps ought to be taken to prevent the formation of the carbon dust or soot on which smoke depends for its perceptible existence. Up to this time chemists have devoted no attention worth much consideration to the subject. We have two ways of accounting for the dust. The one is that it is the indirect result of decrepitation. That decrepitation goes on is obvious, yet it is not enough to explain the fact. The second explanation is that coal undergoes a process of distillation, that carbon escapes in the form of a chemical compound with hydrogen, and the oxygen by elective affinity takes to the hydrogen and releases the carbon in a solid form. Nothing would be gained here by going minutely into the chemistry of the question, or considering how it is that the soot is a solidified gas. To prevent the process occurring is held impossible, and all that can be done is once more to render the carbon gaseous. The furnace process would then consist in the setting free of a hydrocarbon, the precipitation of the carbon as a solid by the abstraction of hydrogen, and the subsequent combination to CO or CO^2 of the carbon by supplying more oxygen. We may concede all this and more, and still the chemist has not settled the question why North-country coal is smoky and Welsh coal is not. It will be readily understood that a general answer to this question is not the thing needed. We lack, besides, an explanation of the reason why the excessively fine carbon dust can only be burned with the utmost difficulty. It has long been held that if smoke is once produced it can never afterwards be burned. C. Wye Williams always held that smoke must be prevented, not burned. It remains to be seen whether or not chemists can help engineers, and suggest some methods of smoke prevention which will satisfy such conditions as those we have indicated when boilers are pressed. It is not too much to say that just now the thing wanted is not a smoke preventer which will also economise fuel, but one which will satisfy the legal conditions under which coal has to be burned for the production of steam. In a word, take care of the soot and the gases may, not being visible, take care of themselves. One method has been suggested and used with success. It consists in sending a fine water spray into the chimney. This washes the soot particles out of the smoke, but the system so far cannot be used on a large scale. It is entirely unfitted for locomotives and steamships, and it would no doubt interfere with the draught in land boilers. But the principle of the thing is right, in so far that it would no doubt satisfy the law.

NAVAL OFFICERS AND WARSHIPS.

THAT naval officers frequently do not see eye to eye with naval architects is a very trite saying, or was but a few years since. Of late less has been heard about it; the country is told by somebody or other that naval officers admire such and such a class and are very pleased with it, and there the matter ends. Now the question is, Are they so satisfied? It is not a question that admits of any very direct answer, because "naval officers" is too vague a term, though the naval officer whose satisfaction is bruited about is generally little more than a unit. It is probably beyond possibility to please all, but the majority are silent. Were they otherwise it would not necessarily be of value, because the view that the men who have to fight the ships are the best judges of them may possibly be nothing but a pretty saying. Numbers of naval officers, men fully efficient for their duties, may not be able to give an opinion of value. The reason is twofold. In the first place, the average naval officer is not invariably able to take a comprehensive view; the part of the ship that most concerns him will appear to him in undue perspective very often. In the second place, sailors are prone to admire a ship because she looks "fine," and that is too often confounded with her fighting qualities by those anxious to glean up the praise. For some little time we have been prosecuting inquiries amongst naval officers with a view to arriving at a general idea as to which ships they hold good and which bad from an all-round standpoint. We have found a great diversity of opinion; but on certain points there was plenty of unanimity. Were it possible to take a vote on the matter, neither the Majestic nor the improved variants of her would take first place; the naval officer's ship is still the old Trafalgar. They admit, of course, that the Trafalgar herself is obsolete in many ways—her turrets have sunk a little, her speed is now poor, her quick-firing battery is very poorly armoured against modern shell fire. But the type is there, and the type is the most admired. The Trafalgar's low freeboard has been much criticised, and no one is more cognisant of her shortcomings in this respect than naval officers, but against this they place the small target and the huge armoured area. They see, in imagination, a modern edition of the Trafalgar completely covered with 9in. to 12in. of Krupp armour—9in. Krupp being as good as the 18in. compound on the present vessel. They compare this with the most modern vessels, and modernity gets the worst of it. The actual ship that most nearly approaches this ideal is the new Russian battleship, Kniaz Potemkin Tavritchesky. She is practically a Trafalgar with modern armour, and her quick-firing battery multiplied by the adoption of twin mountings; and we believe that 75 per cent. of our naval officers would, if given their choice, select this ship in preference to the London. Russia, it is worth while remarking, is *par excellence* the country where the naval officer has most to say in ship design.

As regards our modern vessels, the Majestics are always spoken of as "good ships." The Canopus class are less admired, or rather, such admiration as is expressed for them thins out to liking the way they sit the water, and so forth. About all these successors to the Majestic there is a general feeling that they are all the same thing, and fail to exhibit a marked advance. The new 18,000-ton battleships, of which preliminary descriptions are now going round, have not been cordially welcomed. The objection is that they will carry a mixed armament of 7·5in. and 6in. guns. Progressive naval officers have lost all faith in the latter gun, and many call for its abolition; its day has passed. Against modern ships it is of no more value than a 3in., so far as penetration is concerned—armour that keeps out the latter will defy the other also. On the greatly increased tonnage there is no comment; objections to putting so many eggs in one basket chiefly grow on shore. So, we gather, do many of the objections to low freeboard, so much of what one hears afloat against it seems merely an echo of the shore, not a sea-growth. That is to say, many naval officers seem to think that the advantages of offering a small target counterbalance many disadvantages. They have to be the target, which may account for much. Being the target is a stern ounce of fact.

Another point is one that very possibly few naval designers realise. At the present day if a ship gives chase all the disadvantage is with her. She is more likely to be hit by guns; she cannot torpedo, but stands to be torpedoed, and the problem of a submarine boat left behind to tackle her will soon have to be reckoned with. Taking all this into consideration, quite a good case can be made out for low freeboard, the recognised disadvantages of which are loss of speed in a seaway and frequent inability to fire the bow guns ahead—in a word, disadvantages for a chaser. Low freeboard does not affect guns fired abaft the beam.

Of foreign ships, our naval officers have no high opinion of the Charlemagne class or the Kaiser Friedrich III. The Wittelsbach, Borodino, Benedetto Brin, and so forth, the Naval Intelligence Department has as yet given them little or no information about, so they have no views on. American new types are admired to a certain extent, but there is a tendency to distrust them, as "too good for their displacement." Turning to cruisers, the same idea obtains with regard to the Italian Garibaldi type. Of our own cruisers, the Diadem class are generally held—save by their own officers—to be "rotten ships," of no use at all. The Cressy class are considered to have too few guns, and armour weakened by holes cut in it. They are not admired. Neither are the Essex class. The Asama type of Elswick armoured cruiser is the British naval officer's ideal. The Drake is held to be a passable ship, and well gunned. Many naval officers see the ideal cruiser in the Dupuy de Lôme, or a modern edition of that ship. Protected cruisers, of all types, are held by the modern naval officer to have no fighting value worth mentioning unless they are very big.

Of older ships the Royal Sovereigns are held decidedly inferior to the Trafalgar, and generally out of date, though an exception may be made in the case of the Hood, which is, after all, a big Trafalgar. War service in the Admiral class is held to be tantamount to certain death. There are plenty of officers who think that there are many worse ships than the old Inflexible. The "war junks," Alexandra, Hercules, Superb, Sultan, and so on—the "death traps" of the Navy League—appear to be regarded as superior to the Admiral class.

Thus the average naval view of our warships as fighting machines. Summed up it amounts to this:—We need more guns in our ships at all costs, and the 7·5in. substituted for the 6in. Guns merely protected by shields are useless. A great deal of 6in. Krupp armour is better than a less amount of thicker armour. Speed for battleships does not seem held worth sacrifices. Electric hoists, transmitters, electric gear, and so forth, are all demanded by every seagoing officer of ability. The views of torpedo officers differ from these. They are very simple and comprehensive, for they amount to an opinion that all big ships of every sort or kind are useless, and that the destroyer is the only ship of the future.

The views of a naval architect, quite free from the conditions that are imposed upon designers, would be of considerable interest; but it is a problem whether a designer could dissociate himself sufficiently from the making of compromises to suit divergent ideals to express such an idea.

LITERATURE.

Modern Foundry Practice. By JOHN SHARP. 8vo., 759 pp. with 272 illustrations. London: E. and F. N. Spon, 1900. Price 21s.

THIS work is a successor of Spretson's treatise on "Casting and Founding," which appeared originally in 1878, and after having been re-issued several times, has now been discontinued by the publishers. As compared with its predecessor, the size of the volume has been increased by about one half, but part of this is due to the circumstance that the illustrations, which were formerly issued on separate plates, have now for the most part been incorporated with the text. As remodelled, the whole of the matters concerned in the operations of an ordinary ironfoundry are noticed in regular order, commencing with pig-iron and fuel, and then passing on to the construction of cupolas and air furnaces for re-melting refractory materials, and crucibles, blowing engines, fans and blowers. The more special foundry operations, such as green sand, dry sand, dry sand and loam moulding processes, are treated in considerable detail, many additions having been made in these sections by the present author, who has also enlarged that on machine moulding, although perhaps not quite to the extent that might have been desired. A short account of electric travelling cranes, illustrated by a description of a particular form, and of a switchboard suitable for such a machine, has been added to the chapter on foundry cranes, which also contains numerous examples of other kinds, both hand and power-driven. Some examples of foundries are given in Chapter XXVIII., but they are mostly of ancient types, the greatest novelty in this section being a good detailed article on the cost of moulding and casting, based upon the prices of materials and the rates of wages current in foundries at Glasgow during the first quarter of the year 1900. This is an addition of substantial value, and it is to be regretted that the author has not had the opportunity of renovating the book in many other places. The important subject of casting steel to pattern is entirely omitted; as although there is a chapter headed "Cast Steel," the information given refers only to the making of ingots for forge purposes, it being mostly derived from a "recent" paper by Mr. W. Hackney, which was published as lately as 1875, with an account of a Siemens pot melting furnace at Eibiswald, in Sweden (it should be Styria), and a notice of Mr. Thwaites' experimental open-hearth furnace in the Technical School Laboratory at Sheffield; but there is nothing about steel castings as such—an omission that could scarcely have been expected in a work on modern foundry practice. The chemistry generally requires revision, the chapter on refractory materials being particularly bad, while analysis of pig irons with 1·14 to 2·28 per cent. of sulphur, as given on page 15, and the statement on page 305 that many manganiferous cast irons may contain as much as 10 per cent., but that ordinary pig iron seldom contains more than 5 per cent. of combined carbon, are certainly more curious than useful. In the present age of the world it seems unnecessary to reproduce Mallet's unfortunate speculation that the hardening of cast iron by repeated re-melting is due to the reduction of earthy metals from the slag in the cupola, when it is perfectly well known that the principal cause is loss of silicon from oxidation.

On the question of testing cast iron, the author considers that the tensile strength, although not often specified, need not be directly determined, as a very accurate idea of it may be obtained by multiplying the transverse

breaking strain by a constant depending upon the dimensions of the test bars, which, for those adopted in the experiments recorded, is 7·78, and upon this basis the tensile strength of various pig irons and foundry mixtures are given on pages 44 to 47. It does not, however, appear that these have in any case been checked by direct determination, and a comparison with the Woolwich cast iron experiments, where direct determinations of both quantities were made, no such constant relation is observable; in fact, in several results taken by chance, it varies between 2·7 and 3·6, or more than 30 per cent. The differences seem to be greatest with the stronger brands. Thus, Blaenavon cold-blast pig, whose tensile strength at Woolwich varies for different numbers between 10·33 and 12·78 tons, is credited by the author's formula with 14¾ tons. Hence we are not disposed to admit the accuracy of the formula without confirmatory direct evidence. In connection with this part of the subject it is curious to note that English brands receive different names in Scotland. Thus, Blaenavon becomes Blaneavon, and Madeley Wood Meddleywood; and these apparently are not printer's errors, as they are repeated, and in one place printed in italics. We suppose this is necessary by the difference between the North and South British intonation.

In concluding these remarks, we have to express our conviction of the accuracy of the statement of the preface that the more valuable part of Spretson's treatise has been carefully revised and reconstructed; but, unfortunately, it is equally true that far too much of the useless matter has been reprinted without change, to the detriment of the otherwise meritorious character of the additions made by Mr. Sharp.

SHORT NOTICE.

The "Melbourne Argus" Tables of the Australasian Mails for 1901. London: The *Argus* Office, Fleet-street, E.C. Gratis.—This small pocket-book consists of twenty-eight pages, containing complete official British and foreign mail services to and from Australia and New Zealand, rates of passage, postage, and cable charges, with a coloured track chart of the world, showing the distances from port to port and differences in time. The little work is rendered attractive by the addition of illustrations reproduced from the works of Mr. W. L. Wyllie, A.R.A.

BOOKS RECEIVED.

Who's Who? 1901: *An Annual Biographical Dictionary.* 53rd year of issue. London: Adam and Charles Black. 1901. Price 5s. net.

Subject List of Works on the Laws of Industrial Property (Patents, Designs, and Trade Marks) and Copyright in the Library of the Patent-office. London: Patent-office. 1900. Price 6d.

The Employers' Liability Act, 1880, *and the Workmen's Compensation Acts,* 1897 and 1900. By Alfred Henry Ruegg, Q.C. 5th edition. London: Butterworth and Co. 1900. Price 12s. 6d.

Specifications for Steel Bridges (taken from "De Pontibus"). By J. A. L. Waddell. First edition, first thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1900.

Every Man's Own Lawyer: A Handy Book of the Principles of Law and Equity comprising the Rights and Wrongs of Individuals. By A. Barrister. Thirty-eighth edition, carefully revised, including the legislation of 1900. London: Crosby Lockwood and Son. 1901. Price 6s. 8d.

ROYAL METEOROLOGICAL SOCIETY.—The monthly meeting of this Society was held on Wednesday evening, the 19th inst., at the Institution of Civil Engineers, Westminster, Dr. C. Theodore Williams, president, in the chair. Mr. H. Mellish read a paper on "The Seasonal Rainfall of the British Isles," which he illustrated with a number of lantern slides. He discussed the rainfall returns from 210 stations for the twenty-five years 1866-90, and calculated the percentage of the mean annual rainfall for each season. In winter the largest percentages of rainfall are found as a rule at the wet stations, and the smallest at the dry ones. Spring is everywhere the driest quarter, and the percentages are very uniform over the country; rather larger in the east than in the west. In summer the highest percentages are found in the dry districts, and the lowest in the wet ones. As the spring is everywhere dry, so is the autumn everywhere wet, and there is little difference in the proportion of the annual total which falls in the different districts. As regards the relation between the amount of rain which falls in the wettest and driest month at any station, it seems to be generally the case that the range is larger for wet stations than for dry ones. In wet districts rather more than twice as much rain falls on the average in the wettest month as in the driest, and in dry districts rather less than twice.

THE MAGNETIC FIELD OF ELECTRIC TRAMWAYS.—At a meeting of the Physical Society held last week, Prof. A. W. Rucker read a paper on this subject. Taking the case of a tramway in which the current flows along a trolley wire from the power-house and returns partly through the rails and partly as earth currents, the author has shown that the vertical disturbing force at any point is due to the currents in the feeders and rails, and that the earth currents affect the horizontal force only. Experiment shows that it is chiefly the vertical force instruments which are affected by the establishment of an electric railway, and since this disturbance is due to the wires and rails, it is impossible for an observatory to be protected by rivers or other natural features of the district. A preliminary investigation is based on the assumption that the trolley wires and rails are insulated conductors, and that a fraction of the whole current returns along the rails to the generator. The effect of the railway at a distant point is due to the difference of the current in the trolley wire and the hypothetical uniform rail current, the effect of which at the point considered is equivalent to the actual rail current, which varies from point to point. It is thus shown that the disturbance increases with the length of the tramway, and for a tramway of given length the disturbance is a maximum at points on a line perpendicular to and bisecting it. Experiments made at Stockton on the magnitude of the disturbing force gave, with the vertical force instrument, a leakage of 16·3 per cent., and with the horizontal force instrument a leakage of 15·9 per cent.—a fairly close agreement. The assumption that the terminals of the line are above and below the average potential of the earth by the same amount respectively, and that the leakage at any point is proportional to the potential difference between the rail and the earth leads to the ordinary theory of a Fourier bar. This more accurate assumption has been developed and applied to the results obtained at Stockton. The leakage as calculated from the ampères and volts comes out at 20 per cent. The calculation of the disturbing vertical force gives $10{\cdot}5 \times 10^{-5}$ C.G.S. units, which is in fair agreement with the value 7×10^{-5} actually observed. In conclusion, it is pointed out that for practical purposes it is sufficient to deal with the average return current through the rails, the formulæ for which are quite simple.

DOCKYARD NOTES.

THE naval expert is well to the front just at present. Most newspapers keep their "Own Naval Expert" now-a-days. That of the *Daily Express* is at present on the warpath with phrases that go one better than the *Daily Mail*. It is supposed to be necessary to "lay it on thick" now-a-days to wake the country to the state of the Navy, though we should have opined that the country was fully awake. If, however, it still sleeps, the *Daily Express* naval expert should succeed in giving it nightmare. He has proved up to the hilt his contention that we have very few torpedo boats compared to the foreigners. Neither have we armoured gunboats. The use of the one is about as great as the use of the other now-a-days; destroyers are the torpedo boats of the present day.

THE other crusader is the *Pall Mall Gazette*, where a correspondent weeps over a water-tube boiler. Mr. Weller, of immortal memory, wept for the stage coach, and knew it was better than Puffing Billy. In the cases instanced by our contemporary ships with Thornycroft boilers come in the "horrid example" category. This is absurd. Failures can be directly traced to Bellevilles, but there is not a single instance in our own or any other navy in which disaster can be attributed to the Thornycroft boiler. The fact is that if a propeller gets damaged now-a-days, some one will find the boilers indirectly responsible.

THE Pandora, cruiser, has been out at last for trials. On the thirty hours "half-power," with a mean of 195 revolutions, she made 3698 mean indicated horse-power and a mean speed of 16·7. Coal consumption was 2·11 lb. per horse-power. She is the last vessel of the "P" class, the corresponding trials of which were as follows:—

	Hours.	Knots.
Pelorus	60	4277 = 17·3
Proserpine	60	3615 = 17
Pactolus	30	3631 = 16·6
Pegasus	30	3698 = 17·3
Perseus	30	(not available)
Pomone	30	3604 = 16·5
Prometheus	30	3556 = 17·5
Pyramus	—	3605 = 17·5
Pioneer (foul bottom)	—	3665 = 16·3
Psyche	—	3647 = 16·8
Pandora	—	3638 = 16·7

The Proserpine has Thornycroft boilers, the Pomone, Bleychenden; all the others Bellevilles.

THE new battleship Albemarle will be launched at Chatham on March 5th. On March 20th the Prince of Wales will be laid down on the same slip.

ADMIRAL SIR J. HOPKINS has recently advocated the training of certain numbers of bluejackets as stokers. Seeing that to attain full speed a good 50 per cent. of deck hands have now to go below, there would look to be points in the suggestion. There would be more utility, however, in a rule that raw stokers shall not be sent to ships and counted as efficients.

WE observe that at a recent meeting of the Institute of Marine Engineers Mr. J. R. Ruthven is reported as strongly advocating the value of heredity in naval engineers. The scion of a family of naval engineers would, he said, make a better engineer than the son of a greengrocer. Doubtless this is true; but how many naval engineers does the greengrocery business supply?

A NOTEWORTHY feature of this discussion was the very moderate tone adopted all through. Had naval engineers urged their requests half as moderately, they would probably have had most of them granted by now; a few hot heads, however, spoilt all that. Mr. Adamson, the honorary secretary, made some novel and at the same time relatively practical suggestions. One was that artificer engineers should be eligible for commissions, the other—the more feasible of the two—that Royal Naval Reserve engineers should enter on the supplementary list. The bitterest opponents of either scheme would, however, be naval engineer officers.

THIRTY-SEVEN sets of wireless telegraphs are now installed in the British Navy, or about to be installed. So far as we can gather, the ships so fitted are:—Majestic, Diadem, Melampus, Forte, Camperdown, Ariadne, Naiad, Jaseur, Prince George, Ramillies, Iphegenia, Albion, Amphitrite, Centurion, Barfleur, Hawke, Gladiator, Vindictive, Arrogant, Furious, Canopus, Minerva, Highflyer, Doris, Sybille, Magicienne, Philomel, Argonaut, Endymion, Cressy (not yet fitted), Renown, Charybdis, Crescent, Proserpine, Pomone, Niobe, Endymion. All these carry, or are to carry, Marconi; the Canopus and Jaseur may, however, still have the Jackson system at the moment. The four ships at the Cape may still be using the Jackson at the moment, and the same applies to those on the China station.

IT is stated at Pembroke that phenomenal rapidity is being shown in putting on the Drake's armour plates.

A BELLEVILLE boiler tube burst on board the Mutine and badly injured two men on Thursday, 20th, one of whom has since died.

TRIPLE-EXPANSION ENGINES OF THE FRENCH CRUISER KLÉBER.

ON page 638 we illustrate one set of engines of the French cruiser Kléber exhibited at Paris by the makers, Schneider and Co., Le Creusot. The Kléber is fitted with three screws and three independent sets of engines, with a collective power of 17,000 indicated horse-power. Each set consists of three cylinders. The valves are all of the piston type. The high-pressure has one, the intermediate-pressure cylinder has two, and the low-pressure cylinder three. The valve gear is Stephenson's. The cylinders are 34in. + 48in. + 77in. × 31½in. At full speed the engines make 150 revolutions per minute. Steam is supplied by twenty Niclausse boilers, divided into four groups, two forward and two aft of the engine-room. The pressure is 256 lb. per square inch. The total grate surface is 1100 square feet, the total heating surface, 35,500 square feet. The total weight of engines, boilers, &c., is 1275 tons, water in the boilers included, which gives a total weight of 174 lb. per indicated horse-power. The engines weigh 663 tons, and the boilers 612 tons. The total heating surface, omitting fractions, is two square feet per indicated horse-power.

LABOUR TROUBLES.

THE fear expressed last week that the Taff Vale Railway dispute was only slumbering was realised at the meeting held in Cardiff on Sunday last. There was a large attendance of workmen. The Chairman opened at length, and gave a review of the position of things. By the meeting of the men in October their representatives were instructed to seek an interview with the Taff Vale board of directors, and endeavour to obtain the reinstatement of the men who had come out on strike and had not been re-employed, the improved conditions of service sought for before August 16th, and the removal of the imported men. A large amount of correspondence had passed between the Committee and the management, but they had failed to obtain an interview with the directors. Briefly, the Chairman's report was to the effect that little or no success had attended their efforts, and they now placed the matter before the men for action.

Correspondence was then read. The Taff Vale management pointed out that an interview with the directors was not promised. With regard to the conditions of service which the men complained about, in many instances the signalmen had received 2s. a week advance, wages of guards had increased to 31s. per week, and that of guards working single-handed to 32s. Men in other grades were also well paid. With regard to Christmas Day and Good Friday a bonus to be given for work for three days, in either Christmas or Good Friday week.

A member of the Committee reported an interview with Mr. Beasley respecting the reinstatement of certain men. Mr. Beasley's reply was that he would not under any consideration re-employ them, inasmuch as in several instances the men did not come out on strike with the rest, and refused to do the work they were directed to do. In regard to signalman Ewington, he must apply for a re-appointment if he desired to be retained on the railway. In reference to the two men charged at the quarter sessions and acquitted, Mr. Beasley said it was a miscarriage of justice.

Next followed a good deal of correspondence between Mr. Beasley and the Committee in reference to the imported men. The contention of the men was that the old hands returned to work under the explicit understanding that the imported men should leave in a month's time. This the general manager denied, and pointed out clearly that the promised discharge was implied by the old hands, the promise being, as shown in correspondence, that room would be made for as many of the old hands as possible. Mr. Beasley safeguarded the position of the company carefully by expressly stating that the directors wished to have a free hand, and this was indicated in a letter to Sir W. T. Lewis, wherein the following paragraph appears:—"It is understood that the directors in offering to take back the whole of the men now on strike have retained an absolutely free hand with regard to the men by whom the railway is now being worked."

In reply to this the meeting was informed that when the point was raised of the directors requiring a free hand, and the preceding issue, that room would be found for as many of the old hands as possible, the men who had returned to work were pacified with difficulty, and this was only done by receiving assurances from Sir William and Mr. Bell.

After a considerable debate, Mr. Holmes pointed out that the Executive Committee of the Amalgamated Society of Railway Servants had power to enforce the carrying out of the terms of agreement between the men and the company, and after a lengthy speech, in which he contended that he was not advocating a strike, left it to the consideration of the meeting that they must either submit to the conditions imposed upon them at present, or else present an ultimatum to the company and demand that the terms of the settlement arrived at should be carried into effect by getting rid of the imported men, and agreeing to the formation of a Conciliation Board within a limited time. He was with them in whichever step they took, and with the aid of the Barry and the Rhymney men he maintained they could also compel the company to grant them an eight hours day. The resolution arrived at by the meeting at the close and unanimously supported, was as follows:—"The company be asked to get rid of all the imported men. All the old servants not yet taken back to be taken back immediately. That the company at once state if they agree in principle to the conciliation scheme."

Failing these or any part of them, the Executive Committee be asked to give immediate effect to aforesaid resolutions and enforce them. This result of the meeting on Sunday has caused general disquietude in the district, though the comments amongst leading and unbiassed authorities is, first, that the Taff Vale management has carried out strictly its obligations to the letter by reinstating all those who had not misconducted themselves; and, secondly, that the delayed Conciliation Board arrangement is really the only bone of contention.

On Sunday evening a meeting of railway men was held at Pontypridd, when the principal matter discussed was the case of signalman Ewington, whose position at the end of a conflicting correspondence was submitted in his own words: "That after twenty years' service on the Taff Vale, he was now going to work as a labourer under ground." The meeting ended with a resolution to meet on Tuesday next.

RUSSIAN REINFORCEMENTS FOR CHINA.

WE have in the past described the principal vessels now going to swell the Russian Pacific fleet; a description of them is not, therefore, called for here. It may be of interest to call attention to the change in the Gromovoi, as designed and as she has turned out—see illustration on page 642. A hark back to the original rig will be noted, and some slight changes in the positions of guns upon the upper deck. There is rather more distribution and a less amount of protection—four more 3in. guns being now liable to be put out of action by shell underneath them. The Sevastopol, as we recently announced, has had her short funnels heightened.

The principal thing about this big reinforcement is that the British fleet in the Far East will be hopelessly outnumbered. As regards reinforcing our fleet we have no battleships available—the delay in construction comes home to roost here. Cruisers would be useless. In any case, too, we lack the necessary men to commission any fresh ships; the dearth of officers and men is at present terrible. Comment is superfluous.

RUSSIAN REINFORCEMENT FOR CHINA

(*For description see page* 641)

SEVASTOPOL POLTAVA GROMOVO

MACHINE TOOLS FOR THE CONSTRUCTION OF BELLEVILLE BOILERS

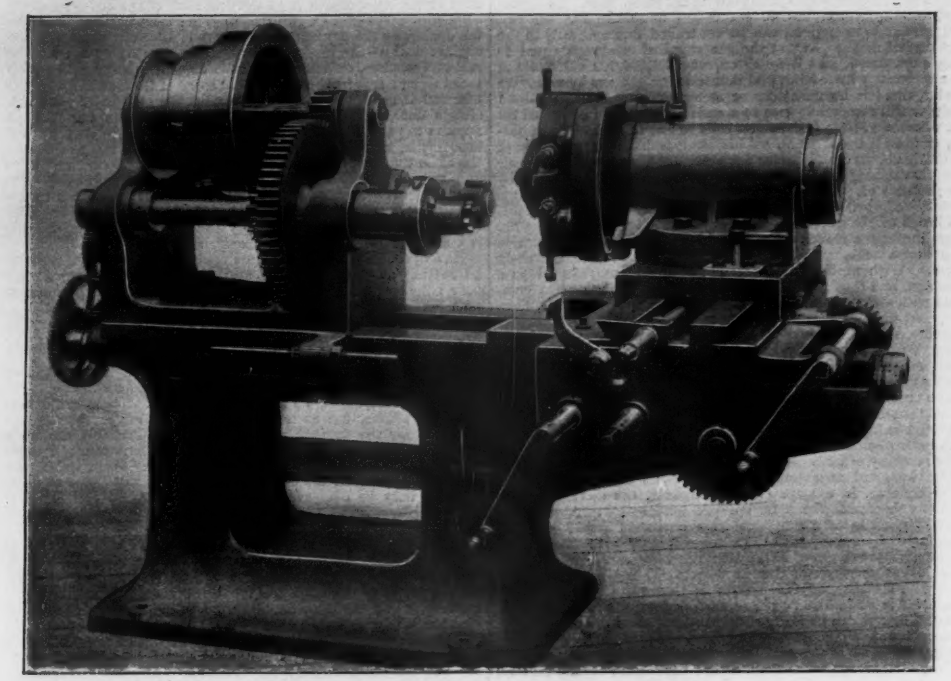


Fig. 1—BORING, FACING, RINGING, AND TAPPING MACHINE

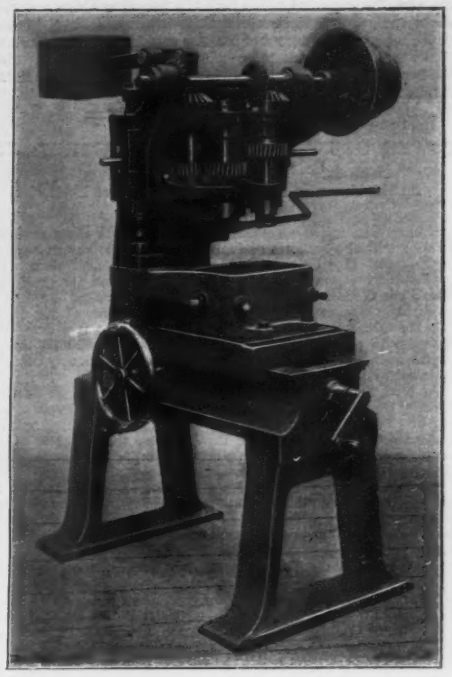


Fig. 2—MACHINE FOR MILLING OVAL HOLES

BELLEVILLE BOILER-MAKING MACHINERY.

A CAPITAL example of the specialisation of machine tools is afforded by the case of the machinery required for the construction of Belleville boilers. These tools are all of simple solid-construction design, solely for the execution of a particular job, and allowing of no errors of misadjustment, and so on. Complete sets of these machines have been made by Hulse and Co., of Manchester, for all the nations now manufacturing the Belleville boiler, and we are indebted to them for the accompanying photographs of certain tools, and the following description of the method of machining the various parts employed in the generator and economiser.

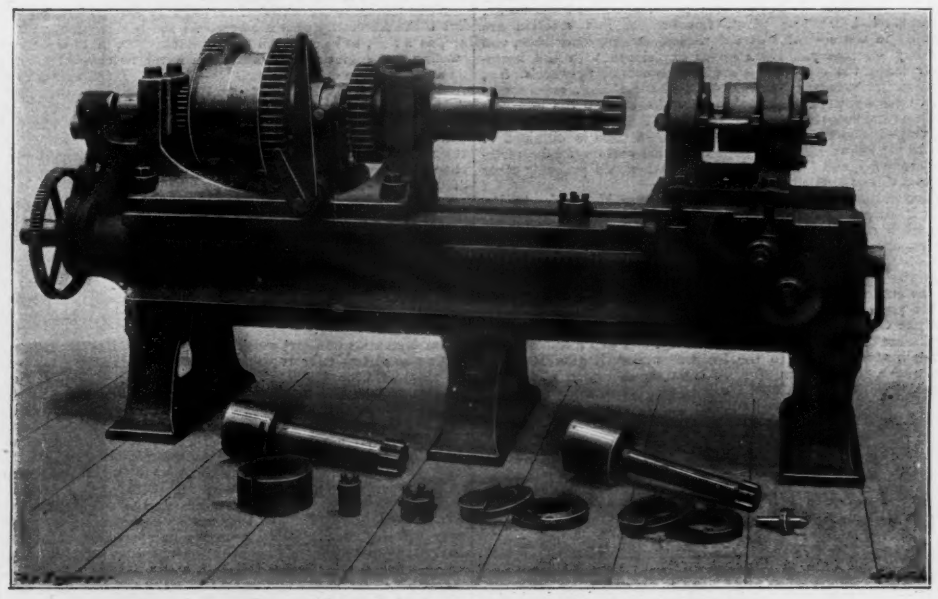


Fig. 3—INTERNAL BORING AND SCREWING MACHINE

The first operation consists of staving the tubes. For this purpose a special compound hydraulic forging machine is provided. It has both horizontal and vertical cylinders and rams, and the tube when under operation is supported on the bed extending in front of the machine by end and steady brackets. After being staved the tube is screwed in a double-ended tube screwing machine which simultaneously screws both ends, the screwing heads being provided with an apparatus for first turning the tube before screwing. In order that irregular tubes may be gripped quite centrally with the screwing heads, the vices are made self-adjusting, and to obtain the accuracy enforced in the screwing of these tubes, the screwing heads are provided with a micrometer rrangement, by which means a fine adjustment up to $\frac{1}{1000}$ of n inch can be given to the dies. Two different sizes of hese machines are made, viz., one for generator tubes and ne for economiser tubes.

For dealing with the junction boxes several special tools are required, the first being the machine for boring, facing, ringing, and tapping the boxes. This machine, which we illustrate above—Fig. 1—is provided with two spindles. The front spindle is employed for boring and facing by means of a cutter head fitted with special cutters, and the back spindle for tapping the hole after it is bored. The machine is provided with two guide screws, which are geared up to give the requisite feeds to the carriage for boring and tapping respectively. The junction box is held in a jig mounted on the face plate of the swivelling junction-box carrier; this face plate is provided with stops to bring the holes in the junction box alternately opposite the boring and facing spindle, and the transverse slide has a steady pin to fix the carrier in its true position opposite either the boring or tapping spindle. The swivelling motion of the carrier admits of the holes being bored, faced, and tapped at the requisite angle, and spacing pieces are inserted between the carrier and transverse slide to suit the various distances apart of the holes in the boxes. The "lugs" of the junction boxes are milled in a horizontal milling machine, the box under operation being held by a specially-designed chucking apparatus which ensures the lugs being machined so that they are in a fixed relative alignment to the holes of the junction box.

The milling of the faces of the oval holes for the lids, at the back of the junction box, is effected by a special two-spindle profile milling machine, which we illustrate above—Fig. 2. The spindles in this machine are adjustable to suit the various pitches of holes for both generator and economiser junction boxes, and both holes are milled simultaneously from a template or model carried at the side of the jig which holds the box under operation.

For making the sockets and check nuts from the tube three special machines are supplied, the first operation being the cutting off of the sockets or check nuts to the required width from the tube. This is effected in a special hollow-spindle triple-tool machine, in which the tube is passed through the hollow spindle, and after having been gripped by the concentric chuck, is parted off into three elements by the three tools carried by a strong slide rest, the distance between the tools being regulated to give the requisite width for the elements. The piece thus cut to length is then taken to a special internal boring and screwing machine—Fig. 3. The sliding carriage of this machine feeds at the required pitch whilst the tap revolves, an accurate thread being thus ensured; and the vices, moreover, are specially arranged to grip the work at the ends and not on the outside, the object being to ensure a cylindrically true thread by avoiding the distortion and springing which has been found in practice to take place with outside gripping. The headstock is provided with a clutch to change the gear readily to give the requisite speeds for boring and tapping respectively.

After being bored and internally screwed, the socket or check nut is taken to a special capstan lathe and threaded on to an expanding mandril, and the faces are then trued up, ringed, and chamfered, and this ensures the truth of the faces with the internal thread, which is a most important

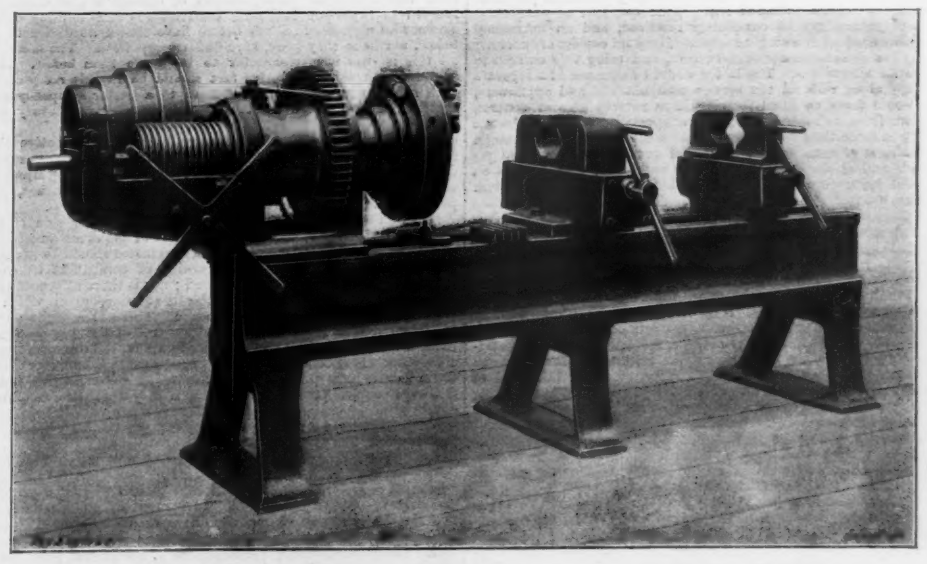


Fig. 4—SCREWING AND CUTTING-OFF MACHINE

matter. For making the nipples from the tube a special screwing and cutting-off machine—Fig. 4—is provided. The tube is gripped in the vices, and then externally screwed and parted off at one setting in the machine.

The other machines in the plant consist of a special machine for screwing tubes into the junction boxes and make the joints, a universal horizontal drilling, boring, tapping, studding, and milling machine for machining the round and oval holes of feed and steam collectors, and a special machine for turning, boring, and screwing end plates and bonnets and bends.

POWER GAS AND LARGE GAS ENGINES FOR CENTRAL STATIONS.*

By Mr. Herbert A. Humphrey, Member, of Northwich.

(*Concluded from page* 618).

Greater Economy of gas engines as compared with steam engines.—Dealing with the question of fuel economy, it is shown that gas engines and Mond producers are more economical than steam engines and steam boilers, because (*a*) the fuel for generating Mond gas is cheaper than the fuel used at central stations for producing steam; (*b*) for a given expenditure of heat, the calorific value of the Mond gas from the producer is greater than the calorific value of the steam from the boiler; and (*c*) the gas engine utilises the heat it receives much more efficiently than the steam engine.

In 1898, for eighty-three electric-supply undertakings in Great Britain, the cost of fuel was 47 per cent. of the generating cost, and 30 per cent. of the total cost per unit. As central stations become larger and get better load factors, the question of fuel economy becomes of increasing relative importance, as it forms a larger proportion of the total costs.

Simplicity and reliability of gas engines.—With regard to the reliability of gas engines, the author gives some remarkable figures relating to a gas engine—called by Crossley Brothers a 60 nominal horse-power gas engine—direct coupled to a Siemens dynamo, in use at the works of Brunner, Mond, and Co., where it is employed along with steam engines generating current for an electrolytic process. This power plant has been under the author's supervision since it started in 1897, and all the gas used by the engine has been measured through a large wet meter, so that the exact quantity used during two years' work is known. The plant runs day and night, and hourly readings of output and all other quantities involved are kept throughout the year. The figures for the two years are given separately in an appendix; they show the difference in results when working on the "hit-and-miss" principle of governing, with some missed explosions, and when exploding every possible time with a somewhat weaker mixture, so as to keep the output about the same in both cases. The engine ran, with an average output for the two years of 88·8 E.H.P., for 16,930·9 hours out of a possible 17,520 hours, or 96·6 per cent. of the whole time. The running included a period of 138 days and nights, during which the engine was run continuously without a single stop. The average indicated horse-power was 114·7, and the average thermal efficiency for the whole of the two years was 25·1 per cent., calculated on the indicated horse-power and the calorific value of the gas used. The cost of repairs has been exceptionally low, and not a single cam or roller shows signs of heavy wear. The only parts renewed in two and a-half years are one set of piston rings, some valve springs, and small brass ignition valves. One of the main bearings had to be repaired, but this was due to neglect in looking after the lubrication. The gas, air, and exhaust valves look as good as ever, and the engine is steadily improving its record. The consumption of coal fed into the producer averages 1·05 lb. of slack per indicated horse-power hour, and the consumption of oil for the last year works out at 0·0235d. per unit. The absence of all glands and packing is a great point in favour of gas as against steam engines. A few words should be added regarding the dynamo, which has run absolutely without any repairs at all. The remains of the original brushes are still in use, and the commutator has never required turning up; it has not even been touched with a sheet of emery, although it has generated about one and a-half million units up to October, 1900. The work of this gas engine is undoubtedly the best on record. It is hoped, however, that such results will soon be a matter of common experience.

In considering the application of gas engines to central station work, it must be borne in mind that the large central station of the future will employ three-phase alternating currents; and the important question arises, Are gas engines, coupled to alternators, suitable for running in parallel? In answer to this the author has seen, at the works of the Solvay Process Company, Syracuse, U.S.A., the first gas alternator which successfully accomplished such parallel running. It is a 150 brake horse-power, three-cylinder vertical enclosed type, Westinghouse gas engine. The cylinders are 13in. diameter, the stroke 14in., and the speed 300 revolutions per minute. The alternator is direct-coupled, and of 75-kilowatt capacity, generating two-phase current of 60 cycles per second at 400 volts, and running in parallel with Westinghouse steam alternators in the same station. No difficulty has been found in running this engine in parallel with the others.

The three-cylinder Westinghouse engines are now being made in the vertical type up to 1500 brake horse-power. Such an engine, which the author saw under construction, had cylinders 34in. diameter and 5ft. stroke, and was intended to run at 100 revolutions per minute. This type is well suited for direct-coupling to alternators. With the more general introduction of such engines, there is little doubt that the difficulties of parallel running of gas alternators will be completely overcome, even if M. M. Leblanc's invention of the "amortisseur" has not already solved the problem. With an additional outlay of capital, the question of paralleling the alternators may be completely removed, and an extremely elastic method of working adopted. It would consist of working all the gas dynamos on direct current, and using this current to run motor alternators. The latter would be situated in a separate building along with all the service switchboards and appliances, and would form an ideal installation as regards ease of control, freedom from noise and heat, and adaptability to supply electric energy in more than one form, so as to meet various requirements.

Steadiness of running is a matter of great importance in a gas engine, and the author has made a number of experiments on the 400 horse-power Crossley engine installed at Winnington. Crossley's arrangement of the two cylinders, so that two explosions take place in one revolution and none in the next revolution, gives a much more unsteady turning moment than the arrangements adopted by Westinghouse, the Premier Company, or Körting, respectively; yet the speed variation is remarkably small.

With the cyclical speed variation brought within such small limits that alternators can be safely run in parallel, the ordinary speed variation, as controlled by the governor, can be readily dealt with. The output of the engine can be controlled by controlling the quantity of gas per stroke, instead of by a "hit-and-miss" system. The thermal efficiency curve is found to be sufficiently flat over a wide enough range to admit this kind of governing, without much loss of efficiency. The 400 horse-power Crossley engine referred to is fitted with a graduated or stepped gas die, upon which the gas lever and knife-edge strike. The governor determines the position of this die and consequently also the amount of gas admitted. This principle is, however, not new.

With the ordinary "hit-and-miss" method of governing, the speed varies 0·976 per cent. on either side of the mean, but if the engine is allowed to explode every possible time—and this is the usual method of working at Winnington—the running is so steady that the variation is only 0·0937 per cent. above and below the average.

* The Institution of Mechanical Engineers.

Gas producers compared with steam boilers.—Turning now to the subject of gas producers as compared with steam boilers, it will at once be obvious that gas under a slight pressure is much easier to handle than high-pressure steam, and when steam mains cease to be necessary, a cause of danger and trouble is removed; also the losses due to condensation disappear at the same time. It is, perhaps, of still greater importance that the working, as between producers and gas engines, can be controlled automatically in the most perfect manner, so that the gas supplied is always equal to the gas consumed. At Winnington, where 1,000,000 cubic feet of gas are consumed per hour, and demands for gas are by no means regular, there is no gasholder or storage of any kind. A Mond producer will respond at once to a sudden increase in demand for gas, whereas a steam boiler takes time to rise to the increased output, and the boiler foreman has his anxious half-hour as the peak of the load-curve arrives for his station. The speed of the air blower furnishing the blast to the producers can be controlled by the pressure of gas in the supply mains, and any fluctuation is automatically balanced so as to keep the supply pressure constant. The limits within which a Mond producer will make good gas are surprising, and a producer can be shut down and left with fire in it for over a week, and still be quite ready to start again at short notice. With producers the stand-by losses are reduced to a minimum, and thus another serious waste is avoided when compared with steam practice. It should be made quite clear, however, that when the Mond plant is arranged for the recovery of ammonia, some steam is required in order to provide the balance of water vapour necessary to saturate the producer blast. This steam can be raised by utilising the heat of the exhaust gases leaving the gas engines, and a large plant has been designed, and will be erected, in which all the extra steam required will be raised in this manner. But where it is not convenient to extract the heat from the exhaust gases, some steam boilers become necessary. Such boilers could be gas-fired, and the control rendered automatic. If the recovery of ammonia is not attempted, less steam is required in the blast, and arrangements can be made to do without the steam boilers. In a large station, however, the sacrifice of the ammonia represents about 4s. 6d. per ton of slack. Also, as the recovery plant is very simple, station engineers should welcome this source of economy with the same readiness with which they will appreciate the use of cheap bituminous fuel.

Cost.—The question of cost is the crucial test, when once the absolute reliability of the system is assured, and its recommendation must be based on the commercial results to be obtained. The cost figures can be fairly closely estimated on the basis of the Mond plant at Winnington, where 150 to 230 tons of fuel per day are gasified. It is shown in the case of the cost of working a central station under a fixed set of conditions, from which all charges on capital outlay for land, buildings, gas dynamos, &c., being capable of estimation from data, which would be somewhat modified to suit each individual case, had been purposely omitted. The station was chosen at 20,000 E.H.P., and the load factor assumed at 100 per cent., 50 per cent., and 33⅓ per cent. respectively. The first case only applied to an electrolytic plant, but the other cases might well represent a central station of the future supplying energy in bulk. The cost of fuel, oil, labour, repairs, and maintenance, ranged from 0·082d. to 0·241d. per unit sold, according to load factor and price of coal.

As regards capital outlay, the combination of Mond producers, recovery plant, gas engines, and dynamos compares favourably with the best class of steam-driven plant, when the boiler-house, chimney, slack-handling plant, foundations, and erection are included in the cost of steam dynamos, boilers, condensers, and auxiliary machinery. From actual experience with 400 horse-power units, the cost of gas engines, dynamos, fly-wheels, &c., with foundations and erection, is £12·42 per E.H.P. capacity, or £16·64 per kilowatt. Adding to this the cost of the complete producer and recovery plant, with its buildings, &c., at £4·62 per kilowatt—including 20 per cent. reserve—a total is obtained of £21·26 per kilowatt. With large units this cost would be materially reduced, and £15 or £16 per kilowatt would probably cover the cost with a 20,000 E.H.P. plant.

In conclusion, the author desires to express his thanks to Dr. Ludwig Mond, for his kind permission to place before the Institution much of the information contained in this paper. Most of the experiments were carried out for Dr. Mond at his expense and that of the great firm of chemical manufacturers with which he is associated, and through Dr. Mond's generosity it has been possible for the author to embody the more important results of this work in the present paper. The author's thanks are also due to M. Adolphe Greiner, director of the John Cockerill Society, for the particulars of the tests made at Seraing, and to Professor F. W. Burstall, the reporter to the Institution Gas Engine Research Committee, for the loan of some carefully-calibrated apparatus, which has been very useful for purposes of comparison. The paper is illustrated by eight plates and nineteen figures in the letterpress, and accompanied by fourteen appendices.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

NAVAL ENGINEERS.

Sir,—The recent report of Admiral Melville, engineer-in-chief of the United States navy, is not rosy reading for those who trust to see some drastic improvement in the status of naval engineers. Reports made by our own engineer officers appointed to watch the American experiment are even more unfavourable. In point of fact, the American amalgamation of executive and engineers has led to engineers becoming deck officers and nothing more. Those who were deck officers before have shown no desire to go below, nor have they gone, save under compulsion. The moral of all this is that it is pleasanter to be above than below. It is well for both sides that this fact should be frankly recognised; such recognition would, I think, lead to a better sympathy and understanding between the two branches—a thing in every way desirable.

The lamentable friction between engineers and executive that obtained a year or two ago is, I am glad to note, to a great extent dying out. The executive as a body certainly do not sympathise with the engineers as yet, it would be idle to pretend that, idle perhaps to hope for it, but there is much less antagonism.

It is well in a case of this sort to examine the other side of the question. Broadly speaking, as the result of inquiries among the executive, I find a general feeling that engineers should be granted control of their own men. The granting of combatant titles—if naval ones—would be bitterly opposed; nor is there at present the slightest prospect of this particular concession, upon which a section of the engineers lay such store. There is a feeling that engineers demand, or will demand, control of fleets as admirals, though I doubt whether one engineer in a hundred dreams of such a demand. It is conceded frankly enough that an engineer officer could handle guns quite as well as any salt-horse executive, but it is always coupled with an opinion that if they did their own branch would be neglected accordingly. There is a general admission, too—for the executive is nothing if not candid—that down below means harder work, less pay, and less chance of "glory."

At the bottom of the problem the great social question is supposed to lie. A careful examination disposes of that. The executive is, as a whole, more aristocratic in his connections than the engineer, but to nothing like the extent of a few years ago. The son of the wealthy tradesman or the successful speculator now has the navy open to him—he certainly did not have it open years ago. The supplementary lieutenants as a class cannot hold themselves socially superior to the engineers. Doctors and paymasters are no more scions of the aristocracy than engineers; doctors, indeed, might possibly total to lower in the scale. All these non-combatant branches are drawn from a large section of the population. Engineers are the sons of admirals, clergymen, tradesmen, lawyers, and dockyard mechanics—it is not easy to call them the sons of one class more than another. But between the executive—now, at any rate, drawn from the first four of the above—and the engineers, there exists a gulf that does not exist between them and the doctors or the paymasters. It exists between these and the engineers also—the engineers, as a whole, are a race apart. The real gulf is, then, evidently not to be explained away as a purely social thing; it is rather the old, old story of the war between the new and the old. Perhaps the new appear aggressive—the new always does, and cannot help itself. In the same way, the old appears to partake of the fossil. In both cases there may be, and probably is, more appearance than reality. In a less acute form the same thing may be observed between "salt horse" executive and "specialists." The one thing clear is that if the engineers were all lords and sons of dukes, and the executive of far humbler social condition, the executive would arrogate to themselves exactly the same position that they arrogate to-day. Engineering is a new thing—hence a prejudice against it.

Having said this, I may continue my examination. There seems no getting away from the fact that the best all-round naval engineer officers are those drawn from the mechanic class. These men are wrapt up in their profession; they have few, if any, tastes or ideas outside it. On shipboard they are unpopular, but they are the men who work. The same class, however, also produce "deadheads"—bright boys who have been overpushed and coached in mere theory. The "socially superior" naval engineer may tend to despise these of his fellow-officers; but though a far pleasanter companion, he is far less capable. There are exceptions, of course, but as a general rule it is the mechanic class, who live for the engines, that do the best. Probably the truth and reason lies in the fact that the stress and strain of "down below" needs a man's whole energies, and time spent on amusements is so much off his working value. It is a depressing idea, and can only be compensated for by high pay. Having to do without glory, the engineer certainly deserves the loaves and fishes that at present he does not get.

This is the view taken by the Admiralty. They dare not, even if they would, attempt amalgamation on American lines, for the executive would be more than up in arms about it. Pay they intend to improve as forced; so far improvements granted in pay are very small. Artificer engineers are being increased; in official eyes the best work comes from men of this class, and eventually, should trouble occur, recalcitrant engineers will be told that they can retire if they like. The ambitious and restless may thus do so—only in the merchant service their prospects and position would be worse. Gradually the commissioned engineer will almost die out, and the warrant officer, the artificer-engineer, replace him. Britannia cadets are receiving more training below than hitherto, presumably with a view to general supervision on "Do this and he doeth it" lines. When the commissioned engineers are decimated, the survivors will probably be amalgamated with the executive—that is to say, to a few everything now asked for will be conceded; for the rest there is gradual extinction. The new type engineer-lieutenant will be much where staff-commanders are or were. This, I understand, is the present solution arrived at by the Admiralty. The casual indifference to vacancies in the engineering branch is thus accounted for.

When this move is realised, there will very possibly be a tempest; but if the Admiralty view is correct—if the best engineer officers are, as a rule, to be got from the mechanic class, if it is a correct surmise that engineers' grievances will never be satisfied short of an amalgamation on American lines—then there are points in the Admiralty solution. The question resolves itself into this, Is the Admiralty view correct? As a body, commissioned engineer officers will say that it is not; the artificer engineers and the executive will say that it is. Neither side will listen to arguments against their view, nor do I see that any outside observer has the slightest chance of investigating with the prospect of learning. The failure of the American experiment, the conclusive proof that engineer officers in the United States navy dislike being below, is bound to be taken as a proof that engineers with grievances are dissatisfied with their profession. "Make our profession better, improve our status, then we will be satisfied," say the engineers; but I can fully appreciate the arguments that will be brought to bear against this. The demand for titles will be played for all it is worth; the professionally superior ex-dockyard apprentice engineer, who is prone to be quite indifferent to his status, will be held up as the ideal engineer officer.

Amalgamation of a sort we shall have in time, but few, if any, of those who struggle for it will profit thereby. It will be like the conquest of China—it has been conquered often, but the conquerors always end by becoming Chinese. The executive will conquer the engineering branch, to become engineers themselves. That, at least, will be the end of the present line of tactics on the part of the Admiralty. The American solution has resulted in engineer officers ceasing to be engineers—they might just as well have resigned *en masse* so far as the navy is concerned, because, as things are, new officers have to be found. What happens next will be interesting. The artificers are said to be clamouring for commissions, and backed, as they are by powerful trades unions, they will get them. Very probably numbers of the present executive will resign, and the old engineers will be left as executive. In this way amalgamation may end, and a navy all engineers be created. It may work quite as well as the old arrangement; in any case it will be an exceedingly interesting thing to watch. Certainly total abolition of one or other of the branches seems a simple solution, perhaps the only possible one. If the Gordian knot were ever so cut in our Navy, it may be taken for granted that, on grounds having nothing to do with the utilitarian side of the question, the engineering branch as now existing would be the one to be abolished. Hence, the wisest naval engineers will probably be those who concentrate their efforts on improved pay, choosing the substance rather than the shadow. In this, all branches of the service will be with them, and they have every chance of securing it. Whatever else they ask, they stand next to no chance of getting as things are at present. It is a parlous state of affairs; the present position of the branch on shipboard is beyond question anomalous and unsatisfactory. The naval engineer is a graft, his profession is yet a new thing, and there is none so conservative as a sailor, be his nationality what it may. The discontented engineers were born too soon, because it takes more than a generation to remove the prejudices of a navy against anything radically different to past usage. It is only comparatively recently that gunnery has become respectable—to this day there are "seamen" who despise it. Naval engineering will have to travel along the same path in all probability. At any rate, there is no present rosy prospect of any short cut to the desired recognition of advanced enthusiasts. There are vested interests in the way, and few things, as we know by now, have deeper roots than vested interests.

Stand Bye.

Portsmouth, December 14th.

Sir,—Many of your readers will share with me the regret which I feel at the turn which the recent correspondence in your columns, on the subject of naval engineers, has taken. It would appear to be the sole aim and object of some of the writers to institute a comparison between the abilities of the engineer officers of the Royal Navy and those of the mercantile marine.

Many will agree that these recriminations are not in the very best taste; that they are not worthy of members of the engineering profession, and but serve to exhibit the absolute want of knowledge, on the part of some of your correspondents, of the difference between the work and routine on board her Majesty's ships and vessels of the mercantile navy.

It has been written by a shrewd observer that "the liner, she's a lady, and the man-o'-war's her husband." Only those who have

studied both sides of the question can truly appreciate this quotation in its bearing on the relative engineering conditions in the two services.

It would require more space than you are likely to allow for the full treatment of this subject, but the case for naval engineers has been very ably set forth by Mr. D. Morison in a paper read before the North-East Coast Institute of Engineers and Shipbuilders. This paper, and the discussion that ensued, are well worth a perusal, and form instructive reading, even to the lay mind. But there are a few points, which, though not new, should always be borne in mind.

Firstly, the boilers and machinery of a man-of-war are designed to work economically at only moderate speeds, owing to weight being required for other purposes.

Secondly, the numbers of engine-room complements are arranged for moderate speeds only, in order to reduce the number of so-called non-combatants on board.

A consideration of these two facts will show that when a warship is running at more than moderate speeds, we have abnormal conditions existing. These conditions do not obtain in the mercantile marine, where the rule is to have machinery of ample design for continuous steaming, and engine-room complements sufficiently large to produce the maximum sea-going speed without difficulty.

With regard to the demand made by naval engineers for executive rank, it should be remembered that naval discipline is totally different from that of the mercantile marine; and demands that officers in direct control of large numbers of men should have power to enforce that control, within certain limits, without being compelled to exhibit to their men an utter lack of real authority, by an appeal to the officers of another department. Also, it is useful to bear in mind that the engine-rooms and stokeholds of her Majesty's Navy are not manned by Lascars, but by Britishers; also that the time-honoured method of persuasion by means of the fist or boot, is not legal in the Royal Navy. Neither is the engineer officer able, at the end of a voyage, to get rid of undesirables. He has to take what the gods provide, and keep them for a whole commission for better or for worse.

Some of your correspondents are so far behind the times as to regard it as an unwarrantable presumption that engineer officers should aspire to fall into line with the combatant branch of the Navy. They apparently consider that we shall cease to become engineers. As well might they have argued that the staff commanders and navigating lieutenants of old would cease to be navigators when the ranks of commander (N.) and lieutenant (N.) were instituted. Surely the profession of marine engineering is not less noble—not to say scientific—than that of seamanship.

The care and good management of marine machinery demand scientific ability, thorough technical knowledge, and sound common sense. The efficient control of large numbers of men under severe discipline requires power of organisation, power to command men, tact, and undisputed authority.

The best system of training is that which produces the greatest number of these essentials in combination; and we believe that the Admiralty education of engineer students, supplemented by subsequent training as a junior officer at sea, is the best system yet devised for the production of a naval engineer officer, capable of managing the machinery, and worthy to control the men forming the engine-room complements of H.M. ships.

Your correspondents may deplore the fact that the profession is officered by gentlemen in the Royal Navy, although the rank and file of the service do not. I would point out that these gentlemen have placed to their credit performances, and professional services, of which even mercantile engineers might be proud, and which have received well-merited recognition. And in ordinary every-day routine on board ship, naval captains do not often accuse their engineer officers of lack of zeal or energy in carrying out the requirements of the service.

One word with regard to recent breakdowns. The Admiralty engineers are the pioneers in this country of increased steam pressures and water-tube boilers. The mercantile engineers are sitting tight and waiting for the best boiler to be developed.

Every true engineer will sympathise with an effort to advance, and will not sneer when, in initial stages, the effort is not uniformly successful. But in how many cases is failure due to faulty workmanship put in by the contractors; or to careless and unscientific treatment of the boilers by their men, prior to the transfer of the machinery to the Admiralty and dockyard authorities?

I submit this question for the consideration of your readers.

ONE OF THE NAVAL ENGINEERS.

Portsmouth, December 20th.

SIR,—At the risk of once more "tiring" the boastful blusterer who signs himself "Fidley House," I offer a few further remarks for his consideration.

Like many people who in a discussion with others find themselves with a weak case, he seeks refuge in the misrepresentation of his opponents' views, and then, to his own satisfaction, proceeds to demolish the statements that were never made.

In the second paragraph of his letter in your issue of December 14th he presents a grotesque travesty of a part of my letter which appeared on November 30th, and which anyone sufficiently interested in the matter to make a comparison of the two letters can see for themselves.

It was in reply to his suggestion that the engine-room crew of a liner should be placed in a battleship to run her in their own way that I took the first incident which came to mind to illustrate what would happen under the conditions which exist on board a man-of-war when at drill, and "Fidley House" thinks it fair to represent that I put this forward as a hardship and a grievance of which naval engineers have a right to complain. It is hard to deal politely with this sort of controversialist. Having started with this false premise, he then proceeds to state that I do not know what hard work is, and follows up with a string of hardships put in the form of interrogatories to me, with the apparent object of implying that I have had none of these experiences, and therefore know nothing of marine engineering, and that he has been through all the terrible trials enumerated, and is therefore competent to instruct the world how to engineer the Navy. Somewhere in his letter he more than hints that I am quite unsuited to my vocation. Well, if it be safe to form these conclusions from letters, one cannot help feeling what a very fine Old Bailey cross-examiner this mercantile engineer would have made.

Like others who have spent much of their life in engine-rooms at sea, I have had my share of hard times; and as he talks about battening down, it may interest him to know that I spent six years in a ship which has so little freeboard that she never goes to sea without battening down.

In my previous letter I stated where "Fidley House" could find all the information that he professes to be in search of, respecting the duties of engineers of the Navy both at sea and in harbour; but he professes to believe that I have referred him to an amusing account of some naval manœuvres that has recently been published. I tell him again that the information cannot be given in the scope of a letter, but may be found in some articles published in THE ENGINEER less than two years ago, entitled "Duties of Naval Engineers," and afterwards issued as a pamphlet of about forty pages. However, I regret to say that I am driven to the conclusion that "Fidley House" cares not one rap for the information he professes to be seeking, but is merely making the subject a peg on which to hang an ungenerous attack on naval engineers in general, although disclaiming this purpose in his first letter. In his second letter, however, he does not scruple to draw unjustifiable and unmannerly inferences in order to represent the Navy engineer as a poor, useless, helpless idiot.

He also expresses the pious wish to have me with him as his "second" for a couple of voyages, just to show me what engineering at sea is like. Well, some years ago I did serve as "second" to a chief who was just such another specimen of the genus bully which I am forced to believe "Fidley House" himself must be, and in due time the inevitable court-martial came along; and it may interest my would-be patron to know that it was not the "second" who was passed over the side when the trial was finished, but all on board were delighted to see the back of one who would no doubt have been a great success in the mercantile marine.

December 20th. A NAVAL ENCUMBRANCE.

SIR,—No one with the interests of the Navy at heart can read without dismay the discussion that has arisen on your leading articles as to how the engineering department can best be administered. It has, as you say, taken the extraordinary form of a dispute as to whether the naval engineer or the mercantile engineer can best manage the machinery of a warship. And this, if you will allow me to say so, you rather encourage in your latest leader, and say that so far the naval engineers have failed to prove that the duties they perform could not be done by mercantile engineers. Now, Sir, let it be understood at once that the naval engineer does not want to prove anything of the kind. He does not care who does the work so long as it is done properly. What he does contend is that, whoever is in charge of the machinery of our warships, or however he may have been trained, will never be able to do those duties properly unless he be given full and complete executive control of his department, and allowed a free and unrestricted outlet for his energies and abilities.

If we are to discuss the system of training, and how to make or obtain the best men, well and good. That is one thing. But the efficiency of the Navy will not be helped by arguing whether the chief of H.M.S. Majestic is better or worse than the chief of the liner of that name. And no good can come of the regrettable tone of "Fidley House's" letter with its "I'm as good as you and better" form of argument. In the past a good deal has no doubt been said of the special duties of the naval engineer, for purpose of comparison with duties and responsibilities of executive officers, and with a view of enlightening the public who were being taught as to his "market value," and how far a Lascar could perform his duties, by men who ought to have known better. Let us drop this at once and for all. You, Sir, have now raised the question of training, and laid upon the naval engineer the onus of proving that the Admiralty system is the best, and that if they cannot maintain this they give their case away. And this is the point I wish to emphasise. My case has nothing at all to do with the training; I do not care twopence at present how you train your man, or where you get him, so long as you get the best man. Let us have transatlantic chiefs, "Fidley House," who you will, but mark this—to keep him you must, as I have already said, give him complete control of his department. Give him this; give him his clear and definite post as head of his department in every respect, with proper rank, and then, if you will, start around and try and get better men still. Alter their training, get them ready made, do anything to get the best results for the Navy; but first and foremost, before you touch the man, alter the system under which he works.

Let us by all means discuss the scheme you have outlined on the method of training or anything else likely to be productive of good and benefit to the service, but I would ask "Fidley House" and others not to further pursue the unprofitable line the discussion has hitherto taken. I can assure him that we have our bad times in the Navy as well as in the merchant service; the elements do not specially favour us; the Red Sea does not cool perceptibly on approach of a warship. I have in my time done all and everything and more than he mentions, with the single exception of running a ship full power for thirty days and nights without a stop. Ocean stretches have perhaps contracted a bit, and in any case coal stowage vetoes the performance. In my present ship, too, it would mean a trip of 12,000 miles, which would only be necessary in the event of a naval De Wet appearing in the next war. I, too, have snatched a little rest on a bag of waste, and can do so again when the necessity arises; but I do not think the efficiency of my machinery, or the discipline of my men, will suffer in any way if I am given suitable quarters, and "Fidley House," who tells us he is a chief engineer, should be the last to sneer at the desire of a chief, either of liner or battleship, to have proper accommodation. We are asked what we do in harbour, and how long we are at sea—a matter over which we have no control. What everyone strives to do, at sea or in harbour, is that his department shall be kept always in such a state of efficiency that at any moment his ship can go at her best pace as long the coal holds out. When he is satisfied of this, if he go ashore and keep his mind and body healthy, so much the better for him and his ship.

December 18th. NAVAL ENGINEER.

SIR,—I regard, as I am sure most of my brother officers must, the contention as to whether the naval engineers or the mercantile engineers are best fitted to perform the engineering duties of H. M. ships as quite outside the province of either of these bodies, and of no benefit to either of them. This obligation rests with the public and the Admiralty, and should certainly be investigated, as the Navy requires the best men. Personally, it has never been my misfortune to meet a naval engineer who professed or displayed incompetence, nor have I met one who was too good for his job, as the saying goes.

All this is but a side issue to the main question raised by the naval engineers, which is, Should not they be accorded that position, of which we have a prototype in the executive officers, which will enable them to carry out their duties in an efficient manner—to maintain the high state of discipline so essential in the engine-room of a man-of-war—and which would also recognise the importance of engineering in the Royal Navy, at present held so much at a discount? These are the contentions of the naval engineers, and the views put forward by them are to have these points settled, no matter who performs the duties they are at present called upon to fulfil.

I am afraid, Sir, that I must entirely disagree with you on the point that any responsibility rests with the naval engineers to prove that the present Admiralty system of training is the best possible. At present it is the *only* one, and who is to say, until another has been tried, that a better one exists in the air? The onus of this also rests with the public and the Admiralty. If the naval engineers are satisfied that the present system is a good one, as I take it they are, more or less, the matter, so far as they are concerned, rests there. It is quite impossible for them to prove that another, which does not exist, is better. This much can certainly be said, that in the earlier days of steam propulsion, when H. M. vessels were not, as now, mere floating machines, the naval engineers were recruited from the mercantile marine and engineering workshops, and the system was not regarded as a success, or, presumably, it would not have been abolished, and the one now in vogue gradually developed.

My opinion as to your first scheme, Sir, is that it is not practical without considerable modification, for the reason that you would be creating, practically, two chief engineers, which would not work, and again because a warrant officer with £600 a year would be in a most anomalous and impossible position, as must be apparent to anyone with a knowledge of the inner workings of H.M. Navy. He would be receiving more, or as much pay as the captain, which I do not think could be tolerated, and his pay would be quite disproportionate to his rank. On entry his position and prospects might be as clearly defined to him as laws could make it, but there is such a thing as human ambition, which would eventually over-step all the rules and regulations which the ingenuity of the best law framers could devise; result, still discontent.

December 18th. CHIEF ENGINEER, R.N.

SIR,—For the benefit of those of your correspondents who desire to enter the discussion as to how engineers should be most efficiently trained for the Royal Navy, I append the curriculum of training which the Royal Naval Engineer students undergo, as it is very improbable that many of your readers have more than a vague idea of the present system. I do not propose to enter into any discussion myself, as I feel convinced that the attached system is far more conducive to the production of an efficient officer than can be the result of six or seven years served solely at the fitters' bench.

CHIEF ENGINEER, R.N.

December 22nd.

Curriculum of training of engineer students for the Royal Navy:

First and second years	... ...	Fitting shop
Third year	8 months	Fitting shop
	1 ,, ...	Torpedo shop
	3 ,, ...	Fitting afloat
Fourth year	6 ,, ...	Fitting afloat
	1 ,, ...	Coppersmiths' shop
	1 ,, ...	Smiths' shop
	1 ,, ...	Foundry
	1 ,, ...	Pattern shop
	2 ,, ...	Boiler shop
Fifth year	3 ,, ...	Fitting afloat
	2 ,, ...	Ship construction
	1 ,, ...	Pattern shop
	1 ,, ...	Foundry
	5 ,, ...	Drawing-office

School.—Two mornings and two evenings a week. Voluntary classes and special lectures in addition in evenings.

During third and fourth years one evening—two hours—a week is spent in drawing instruction instead of school.

Engineering lectures, from 3 to 4.30 p.m.,—

First year	12 in number	Students leaving factory at 2.30 on lecture days
Second ,, ...	,, ,,	
Third ,, ...	,, ,,	
Fourth ,, ...	,, ,,	
Fifth ,, ...	18 ,,	

Other lectures in special subjects given at convenient times in lecture-room:—

Metallurgy, about ...	12 in number	Each taking about one hour from factory time
Engine design	,, ,,	
Workshop appliances...	24 ,,	
Electric lighting	6 ,,	
Mechanical drawing ...	12 or more	

Instruction in machinery under way is given in H.M.S. Sharpshooter, which commissions from 1st March to 30th September for the purpose. Here students do all the functions of watch-keeping from stoking upwards. Each fourth-year student averages six days and twelve afternoons at this work, and fifth-year students about half as much again. All repairs made good by students at end of season.

At the end of the second year an intermediate examination is held, for which the total marks in obligatory subjects are 3700, and students who fail to obtain passing marks—1480—are dismissed.

At the end of each year examinations in engineering and other practical subjects are held, and after two years students are required to obtain 30 per cent. of the maximum marks to pass and be retained.

Proficiency in practical engineering and shipbuilding are considered essential in all examinations.

At the final examination at the end of the fifth year, those who obtain 60 per cent. on the combined total of the obligatory and optional subjects are allowed to proceed to the Royal Naval College, Greenwich, for a further course of instruction—this is for nine months, except for the three or four who come out at the top of the list; these remain for two further periods of nine months each.

Those who obtain 50 per cent. and 30 per cent. respectively are granted second and third-class certificates, and go to sea as probationary assistant engineers, when for two years they may be regarded as completing their training. At any time those students who fail to make satisfactory progress, or give no hope of becoming efficient officers, will be discharged from the service.

During the whole of their training the engineer students are borne on the books of one of H.M. ships, and are under naval discipline. They are also drilled and taught how to use the rifle, &c.

The following are the subjects taken at the final, or fifth-year, examination:—

I.—*Obligatory.*	II.—*Optional.*
General paper in elementary mathematics and mensuration	Higher algebra, trigonometry, and conic sections
Statics, hydrostatics, hydraulics	Differential and integral calculus
Dynamics	Practical physics
Chemistry	Design of details
Physics	Engineering
Applied mechanics and graphical statics	Total marks, 3200.
Elementary theory of mechanism and machinery	
Heat, combustion, and metallurgy	
Steam and the steam engine	
Practical engineering	
Workshop appliances and practice	
Mechanical drawing	
Total marks, 6800.	

VENTILATION AND HEATING.

SIR,—I fully concur in the opinion expressed in your issue of the 14th December last, by your correspondent Mr. Alfred J. Allen, as to the desirability of keeping ventilation and heating for ordinary purposes as simple as possible. His suggestion as to a vertical shaft at the top of a room being provided with a lamp underneath it to create a vacuum is undoubtedly a good one; as indeed are his other ideas. It seems to me though, that one of the best systems extant for ventilating and heating is that obtainable by a heated air apparatus. There are many such in existence; a stove heated with either coke, or preferably by gas, is placed in a cellar, ducts from which lead into the rooms required to be heated, having gratings at the floor level, through which a constant stream of heated fresh air is flowing.

At the works here I have had fixed for some time a warm-air gas stove, which has given perfect satisfaction. Pure air enters from the outside of the building into a chamber at the base of the stove and is passed through a series of vertical tubes, around which the gas passes on its way to the flue exit, these tubes therefore draw a regular supply of heated fresh air into the room. In one of the tubes a water suppy is arranged for if required, to keep the air moist, but this in my opinion is not wanted except in special cases arising from illness, such as those of bronchitis, asthma, or chest and lung affections generally. Many advantages are at once apparent from this heated air system.

The air in the room is constantly being changed by the continuous supply of hot fresh air. Exhausted and impure air is drawn up the chimney by a provision of orifices in the chimney plate at the floor level. No draughts are possible, as the air in the room is necessarily under a small pressure; and the oxygen required for combustion is always supplied by the incoming hot fresh air. Indeed all the advantages of the plenum system are secured without any complicated system of mechanical appliances or apparatus. Doubtless the various makers of such stoves could and would enlarge upon their good points, but in my opinion some such design is the best form of stove for ventilating and heating purposes. The uniform temperature of every part of a room so ventilated and heated is a great advantage. The principle is one which will certainly commend itself to your readers.

Perhaps Mr. Allen will give the matter his consideration and express his views thereon.

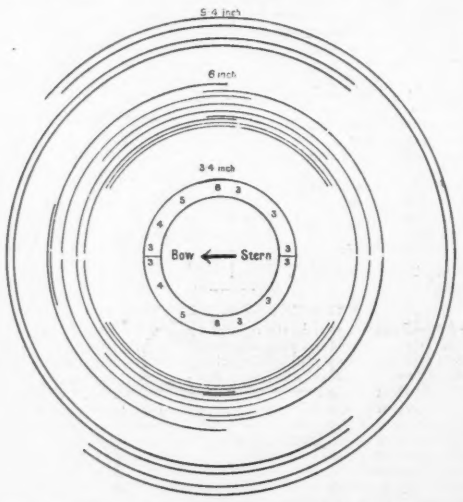
EDWARD A. HARMAN, Engineer and Manager Gasworks, Huddersfield, December 19th.

GERMAN BATTLESHIP, WITTELSBACH.

GERMANY, more even than we are, is convinced that battleship fleets should be homogeneous. So much so is this the case, that though paper sacrifices have been made to remedy the worst defects of the Kaiser Friedrich III. class, the original standard ship, other defects have been repeated.

The Kaiser Friedrich is a well-known ship, and though no single plan published of her in England is absolutely correct, the error is confined to a single particular. We refer to the big guns. In the *Naval Annual* and in all other annuals these are shown as turrets, without armoured bases. This is incorrect; the real mounting is exactly like that in the Wittelsbach, Fürst Bismark, &c., that is to say, a barbette, with a hooded shield above it. This makes the Kaiser Friedrich a much better ship than she looks on paper; but the main defect, the mounting of the 6in. guns at a great height, with no protection to their bases other than the armoured hoists, remains. It is the penalty that accompanies the advantages of a lofty gun position. We tremble to think of the effect of a big shell bursting underneath all that nest of artillery. In the Wittelsbach this—the great defect of the Kaiser Friedrich III.—is remedied, and much of the lofty altitude sacrificed.

Another defect of the Kaiser Friedrich is the very ingenious end-on fire. It is exactly the sort of thing that various well-meaning landsmen critics have called for here. It is essentially pretty, and also essentially non-nautical, for it is marred by certain hard facts. For instance, when a gun is fired, it does something more than project a shell. It also projects a volume of flame and a concussion known as the blast. Even from a 12-pounder the blast is such that anyone at an open port-hole underneath is buffeted by it. Were he in the act of firing with rapid aim through that port-hole, he would be as likely to hit the moon as the object aimed at. Now a 6in. gun, instead of a charge of about 12 lb. of cordite



THE WITTELSBACH.—Diagram to show the arcs of fire. Outer series of circles 9·4in., middle series 6in., inner circle 3·4in. guns. In the outer and middle series, each circle indicates the arc of a single gun. In the inner circle the separate arcs are not shown, but the number of guns bearing on any given point is stated.

or other modern powder, will have a charge of about double that amount, and a blast considerably more than double. A big gun, again, has an enormous blast, out of all proportions to the relative increase in size. The German 9·4 may not be as bad as the 110-ton gun, the blast of which in the Sanspareil once stove in a deck and killed a man sleeping below, and on another occasion wrenched away much solid metal; but if a man stood directly below it when fired, the collection of enough charred remains to justify an inquest would entail considerable difficulty. Inside a casemate he is, of course, largely protected from the concussion, but the back fire can still get at him through the port. In our Majestic class we have found that 12-pounders under the big guns cannot be manned without grave risk of accident when the big guns fire on the beam. Now, wherever the big bow guns of the Kaiser Friedrich III. fire, it seems to us that they must drive a back fire into a casemate packed just below them. In the Wittelsbach this same defect exists. Of the eight 6in., two 9·4in., and six 3·4in. that can theoretically be fired right ahead, and make, on paper, such a fine "energy of fire," we believe only a fraction could actually be employed. Similarly, aft in the Kaiser Friedrich—this defect is remedied in the Wittelsbach—two 6in. have muzzles nearly touching the sighting hoods of the after big gun turret, two more 6in. and some 3·4in. fire more or less over it, and two other 6in. send a blast on either side to swell the total. This means a constant volume of flame and heat, to say nothing of the noise and smoke—for smokeless powder is not absolutely smokeless—around the man sighting the 9·4in. Will he or his eyes survive it, and if he does, where will his projectiles go? This thing the Germans would look to have realised, for the Wittelsbach—as an inspection of the plan will show—is free from this defect. But the minor edition of it forward remains. The mere expectation of a blast will ruin any man's nerve; indeed, anticipation is worse often than reality.

It may, of course, be argued that there still remains a very fine arc of fire to each gun, and to some extent this is true, but only to some extent. In the Kaiser Friedrich there is "interference" all round save on the broadside; and one has only to compare her with any new French ship—in French ships the end-on fire is quite as eagerly sought—to see how much more practicable are our neighbours across the Channel than the Germans. In the Wittelsbach a leaf is taken out of the French book to a considerable extent.

Yet another peculiarity of both German types we cannot feel our ground enough to set down as a defect. We refer to the big guns, which are 9·4in. only. Every other nation has adopted the 12in. The 9·4in. has very good penetration, but it is absolutely useless against a modern belt or turret. On the other hand—so greatly has armour improved—the 12in. is equally useless at anything over 2000 yards. More, no 12in. in existence could get to the engines of most modern ships, save at very close range indeed. The battle of the future will, therefore, see more and more reliance placed on shell. Presumably the German argument is that chances to use shot will rarely occur; that a big shell between the big guns will put them out of action as surely as a shot, while as a 9·4 will fire rather quicker than a 12in., it is more likely to hit.

All this may be true. The only thing is that the same reasoning applies to an 8in., or even a 6in., for in a given time most guns discharge shell doing equal damage: it is a choice between many small and few big. The few big, however—so experience has shown—do a damage quite disproportionate to their size. An 8in. shell of 200 lb. will burst far more destructively than two, or even three, 6in. of 100 lb. each. Presumably there is virtue in the concentrated blow. If all this reasoning is followed, all that remains is to select a gun that gives the best mean result, and presumably the Germans favour the 9·4 as a big shell gun, for much the same reason as other nations have selected the 12in. in preference to the 13·5in. or 16in., once more powerful than the 12in., and which would certainly be infinitely more powerful if of modern make.

A 16in., on the lines of the 12in., Mark IX., would get through the thickest armour at almost any range—for that matter, a new 13·5in probably would. As things stand, and thinking only of ships now completing or building, the question whittles down to this. A 9·2in. frankly disclaims any armour-piercing ability; the 12in. is impotent against turrets or vitals at most ranges, but in most cases it can drive in portions of the water-line amidships. Can these holes be plugged, if made?* Are they at all likely to be made? The selection of the heavier or the lighter gun really turns on little but that. Handiness, and so on, does not enter, for the 12in. IX. is as much a quick-firer as the 9·4in., and quite as easily managed. It is not even certain that its rate of fire is less. It is, to be sure, a good deal heavier, so that weight saved on the lighter guns can go in extra 6in., and such like, but that is about all.

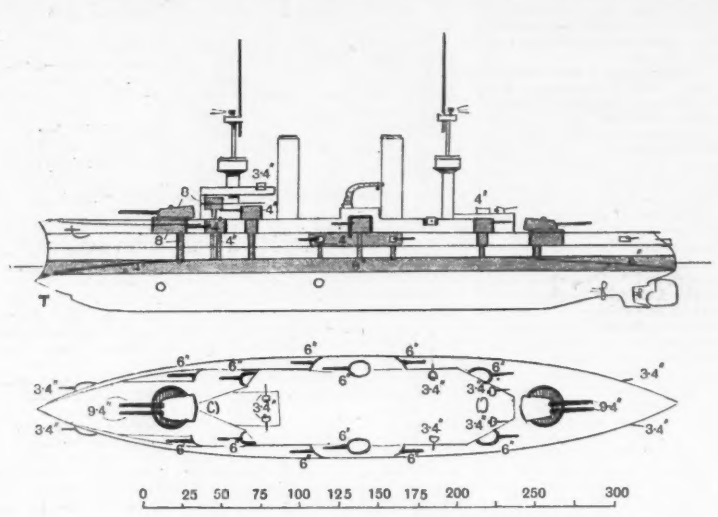
Particulars of the Wittelsbach are as follows:—

Displacement	12,000 tons
Length	377ft.
Beam	67ft.
Draught	28ft.
Guns—Primary	Four 9·4in. in 10in. barbettes and cupolas.
„ Secondary	Eight 6in. in a 6in. battery. Four 6in. in turrets (6in.). Four 6in. in casemates (6in.).
„ Tertiary	Sixteen 3·4in. (20-pdrs.). Twelve 1-pdrs. Eight machine guns.
Torpedo	Five submerged tubes (one of them in the bow).
Horse-power	15,000
Speed	19 knots
Screws	Three
Boilers	Thornycroft (Schültz)
Coal capacity	About 1900 tons

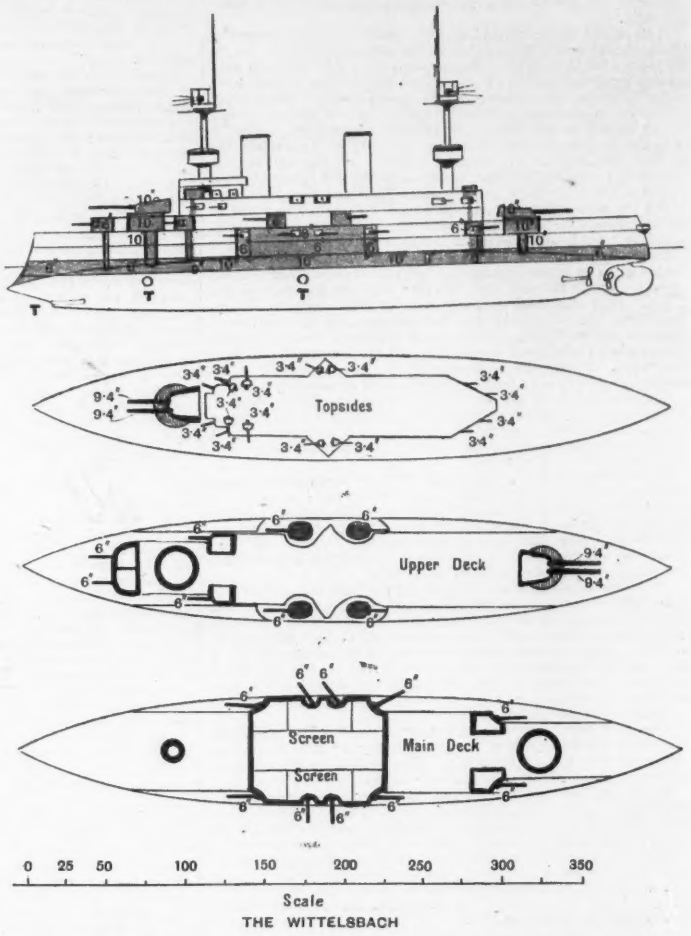
*A 12in. entry hole becomes anything from 8ft. to 10ft. at exit. The piece driven before the shot splits up, and would tear to pieces any bunker walls or any cofferdam that it touched.

The armour is all Krupp system. In addition to that noted above, there is a belt 10in. or 9in. thick amidships, reinforced by a protective deck 3in. thick, and by coal protection. At the ends the belt goes down to 6in. In British ships 2in. or 3in. is held to suffice.

Amidships there is a 6in. redoubt, above which is the battery, and above again turrets, all 6in. in thickness. The battery ports are indented so as to give a wide angle of fire. The 3·4in. guns, it will be noted, are grouped in pairs; and it is characteristic of the ship that there are plenty of spaces without guns in them. German design, hitherto, has exhibited a marvellous fancy for guns all over the ship and in every possible place. Other details are sufficiently obvious from our illustrations.



THE FURST BISMARK



THE WITTELSBACH

The accompanying diagram shows the arcs of fire of various guns, and the number that train on any given point. The fire before the beam is, it will be noted, better than the fire astern, which is presumably an indication that Germany expects to attack in the future. French ships exhibit a tendency in the opposite direction, and French tactics trend to those of a "runaway" order. By this we do not mean flight; but a determination to make use of such facts as that it is easier to shoot straight if you are firing astern. The difference is not very much, but coupled with other differences alluded to above, is a tolerably clear indication that a brighter intellect is the *deus ex machina* in French designs than in German. The assumption is, too, that it is carried into details of the sort that one does not hear about. French ships look very bad on paper in certain respects, and there is a great tendency over here to decry many things that are essentially French in design; but we are bound to admit that if one carefully and honestly examines any characteristically French thing, a reason is always to be found at the bottom of it. In German ships there are few signs of this careful reasoning, though it is what one would expect to find. This is curious enough to be noteworthy.

What, for want of a better term, we may call the evolution of the Wittelsbach class is of some interest. The germ-idea is to be found in the Fürst Bismark, which is by way of being an alternative design to the Kaiser Friedrich. She is called an armoured cruiser, but cannot be so regarded. Her armour is a little thinner than that of the Kaiser Friedrich, and she carries twelve instead of eighteen 6in. guns, in revenge for which—as the French phrase runs—she has a little more speed. Now, in the Fürst Bismark we find the 6in. armoured battery topped by turrets, and other guns in casemates or turrets, well away.

In the modified Fürst Bismark, the Prinz Heinrich—a vessel with which THE ENGINEER dealt at length not long since—we find armour placed under the battery, and the battery grown in importance. In the Wittelsbach precisely the same idea is visible, only still more guns go to the central group.

Whether the Germans have really reached their standard, as they imagine, is another matter. Probably it is a temporary one only; the Kaiser Friedrich III. used to occupy this position, but she has not held it long. However, for the present, no new German ships are to deviate from the Wittelsbach design.

IT is stated that in a village called Fletching several wells have been closed by the local authorities in consequence of oil having been discovered in the water. It is imagined that this oil is petroleum, as at Heathfield, not far distant from this place, many traces of petroleum deposits occur. There is also a supply of natural gas in this village, which has been utilised for some time past for lighting the railway station.

THE PRODUCTION OF DISTILLED WATER FOR ICE-MAKING PLANTS.*

By HAL WILLIAMS, A.M.I.M.E., A.M.I.E.E.

THE process of distilling water for ice-making has not, up to the present, attracted much attention in this country, as it is only in recent years that ice has been used to any extent for table purposes, and, the demand being small, the imported clear natural ice has been sufficient to supply all wants.

Ice drawn from the deep Norwegian or Swedish lakes is probably as pure as natural ice can be, but unfortunately as the demand has increased ice has been placed on the market which has been harvested from less commendable sources. As a result, inquiries have been made, and a demand has sprung up for hygienic ice, or, in other words, artificial ice made from pure distilled water,

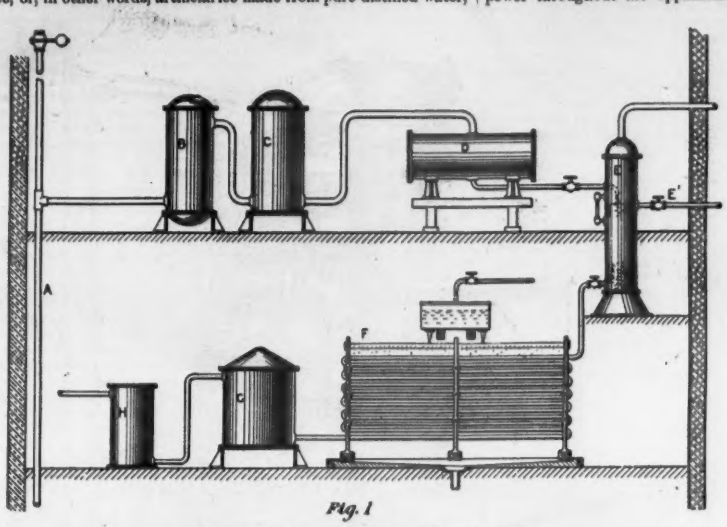


Fig. 1

DISTILLING PLANT FOR ICE FACTORY

and it is to the fact that this demand can be readily and economically met that the great impetus which has recently been given to the establishment of ice factories is due.

The early manufacturers of ice were quite content to turn out an article which was cold and nothing else. No special care was taken to make the ice either pure or clear, and the cans were filled direct from the public water supply, or with water pumped from a well on the premises.

Given a pure water supply, it is quite possible to make clear ice direct from the water by agitating it during freezing, so as to expel the air, and there have been many inventions to obtain this end, but they are very nearly all open to some objection or other, the majority being cumbersome in themselves, unreliable in their performance, and very much in the way when the cans have to be taken out of the tank. They also have to be carefully watched to prevent their being frozen in.

Clear ice can be made from ordinary water by means of the cell and plate systems. The former, however, is very little used, and the latter is open to objection on account of the length of time that the blocks take to freeze, and consequently the size of plant necessary for a given output.

All the troubles relative to these processes can be avoided by distilling and de-aërating the water before it is put into the freezing cans. This process has met with great success, and its objects may be summarised as follows:—(1) The de-aëration of the water. (2) The purification of the water. (3) The making, with absolute safety from contamination, of clear pure ice from water obtained from a well sunk on the site of the factory, so saving the expense of buying the water from the public supply.

Further, there is no doubt that the public prefer clear ice to semi-opaque ice, and that they will be willing to pay a higher price for it; also there is a commercial value attached to the expression, "Ice made from pure distilled water," as signifying freedom from pathogenic bacteria.

The distilling plant which is most commonly used in ice factories is shown diagrammatically in Fig. 1. In this arrangement the distilled water is obtained by condensing and purifying the exhaust steam from the engines, live steam being added to make up any deficiency. Referring to the diagram the exhaust steam from the refrigerating engines and other machinery comes up the pipe A, which is fitted with an automatic relief valve, loaded so as to give the steam a back pressure of about 5 lb. on the square inch, and also for use in case it is necessary for any reason to exhaust direct to the atmosphere. When the distilling apparatus is in use this valve is closed, and the exhaust steam is passed through the steam scrubber B, where it is robbed of its grosser impurities, such as lubricating oil, &c., into the feed-heater C, which may be of some well-known type, such as the Berryman. From this it passes into the surface condenser D. As there is no vacuum, no air pump is required, and the condensing water is the waste from the condensers of the refrigerating agent. As soon as the steam is condensed it runs off into the re-boiler E, where it is violently re-boiled by a steam coil. Any air it may have absorbed is driven off, and the grease passed by the steam scrubber, and other solid matter, rises to the surface and is skimmed off through the pipe E^1. Preferably the skimmer should be a separate vessel. From this vessel it flows into the cooler F, where it is cooled. It then passes away to the filter of charcoal or other substance G, and, after passing through the final filter H, flows away to the storage tank, which is kept carefully covered, and in due course fulfils its destiny in the ice cans.

It will be seen that the purity or otherwise of the distilled water depends entirely on the amount of attention that is given to the re-boiling and filtering apparatus, and there is only "a man" with his own idea of cleanliness between success and "a taste in the ice." It is not the most economical method, as no use is made of the latent heat of the steam.

In considering the question of distilling water, it must be realised that at atmospheric pressure it takes 966 B.T.U.'s to turn 1 lb. of water at 212 deg. Fah. into 1 lb. of steam at the same temperature, while afterwards it only requires the addition of 126 B.T.U.'s to raise that pound of steam to 100 lb. pressure on the square inch. The 126 B.T.U.'s are used up in the steam engine, but the 966 B.T.U.'s remain in the steam, and have to be taken out by the condenser before it can be turned into water. This latent heat requires coal, and so costs money to make, and it is only right that it should be made use of if possible. Fortunately the means of doing this are ready to hand, and by the use of a double or triple effect it is possible to utilise the latent heat and obtain the boiling and evaporation of a larger quantity of water than is supplied to the apparatus in the shape of steam. A diagram of a triple effect of the most simple kind, as arranged for distilling water, is shown in Fig. 2. The principle on which it works is the physical law that in condensing to a liquid the sensible heat of vapour is retained, while the latent heat is given up. In the diagram A, A^1, A^2 are the three pans or pots constituting the effect. Each of these pans is divided into two parts—an upper and a lower. These two parts are connected together with a number of tubes, the space round these tubes being filled, in the case of A, with exhaust steam from the engines, which enters through the pipe B, and in the case of A^1 and A^2 with vapour from the preceding pan.

The water to be evaporated enters through the pipe L, and circulates inside the tubes and above and below the tube plates. The top of the pan A is connected to the steam space of the pan A^1, and the top of that to the steam space of A^2, the top of A^2 being connected to the surface condenser. The lower portion of the liquor space in A is connected by the pipe C to the upper portion of A^1, and the lower portion of A^1 by the pipe C^1 to the upper portion of A^2. It will thus be seen that, as soon as the vacuum is started in the condenser, it will be felt in decreasing power throughout the apparatus. Now, if a vacuum of 4in. to 5in., corresponding to a temperature of 203 deg. Fah., is maintained in A, the water in it will readily be evaporated by the exhaust steam from the engine at a temperature of 223 deg., and the vapour from this pan will readily boil the liquor in A^1 under a vacuum of 14in., corresponding to a temperature of 182 deg. Fah., and the vapour from that will readily boil the liquor in A^2 under a vacuum of 25in., corresponding to a temperature of 125 deg. Fah.

When the apparatus is at work the exhaust steam enters through the pipe B and boils the first effect A, the condensation being withdrawn through the pipe D and returned to the boiler. The vapour from A passes through the pipe E and boils the second pan A^1. The vapour given off by the boiling water in A^1 boils the water in A^2, the vapour from which is condensed in the surface condenser. The water passes from pan to pan on account of the difference of vacuum, and the distilled water is taken by the pipes I and J attached to the subsidiary pumps. Each pan can, when idle, be emptied by means of the pipes and valves K.

In practice the tubes are generally laid horizontally with the steam or vapour inside, and about 6 lb. of water evaporated per square foot of heating surface per hour is very satisfactory.

The pure distilled water is delivered from the pumps attached to I and J and from the air pump of the condenser into a tank placed in some convenient position, from which it is taken and, preferably after passing through a Pasteur filter, is delivered to the ice cans through a proper filler.

The advantages of this apparatus are:—(1) That by making use of the latent heat, for every pound of steam used in the first effect it is possible to obtain from 2 lb. to 2½ lb. of pure distilled water, instead of under 1 lb., as in the apparatus described in Fig. 1. (2) The steam from the engine, with all its impurities, is, after having the oil removed, returned to the boiler as feed-water, and is not used for ice-making. The disadvantages are:—(1) The back pressure on the engine causes water in the cylinders, and there is an absence of the economy obtained from working condensing. (2) The large amount of heating surface which has to be provided, and therefore the increased first cost. (3) The trouble of having to draw off the product of the various effects through vacuum pumps, and the expense of keeping these in order. These disadvantages can be overcome in a somewhat similar apparatus which will give an equal quantity of water per pound of primary steam, and in connection with which the refrigerating and other engines are worked with a vacuum in their cylinders, their exhaust steam being condensed in a surface condenser in the usual way.

The first effect of the evaporator is quite independent of the engine, and is heated with live steam from the boilers reduced to a pressure of about 25 lb. to the square inch above atmosphere, and the last effect exhausts into a condenser at atmospheric pressure. The water to be evaporated passes through an exhaust steam heater placed on the exhaust pipe of the engine, and between the engines and condenser, and so reaches the first effect in a very hot state.

The advantages of this apparatus are:—(1) No back pressure on the engine, and consequently an economy in its steam consumption. (2) The small amount of heating surface necessary. (3) The small space occupied. (4) The low first cost. (5) The convenience of being able to draw off the product of the effects by gravity and without an air pump. (6) The fact that the distilling apparatus is entirely independent of the rest of the plant.

With regard to No. 2—considering that the difference in total heat between exhaust steam at 5 lb. and live steam at 25 lb. is very small—there would seem theoretically to be no reason why the heating surface should be less with live steam than with exhaust, but it has been found in practice that the little extra pressure makes a considerable difference, reducing the necessary heating surface considerably.

In order to work a triple effect, it is necessary to have a certain range of pressure. Thus, if the exhaust steam is at a pressure of 5 lb., then the vacuum in the condenser must be equal to 12 lb.; but if the exhaust steam is at a pressure of 25 lb., then there need be no vacuum in the condenser. The process of interchange of heat between the various effects is exactly the same as already described, and the latent heat is made use of in exactly the same way.

Unfortunately, as will be shown later on, though the live steam effect is an exceedingly valuable piece of apparatus, it cannot compete in economy with the same apparatus using exhaust steam. It is of great value, however, in cases where only a small portion of the ice produced is made from distilled water, as then the main engines can be worked condensing, and economy secured in this way.

The live steam triple effect, as made by the Mirrlees, Watson, and Yaryan Company, of Glasgow, under the Yaryan patents, is illustrated in Fig. 3. Its principle of working is the same as the sextuple effect about to be described. The apparatus as used for exhaust steam is exactly similar in principle, but, of course, has an air pump; and, owing to the greater heating surface required, is larger for a given output than the one illustrated.

Of course, it is quite possible to heat the primary coils with live steam, and have a high vacuum in the condenser; however, this is in a double or triple effect of no material advantage, but it is the only possible method of economically using the sextuple effect.

A multiple-effect apparatus that has shown wonderful economy, and which has been extensively adopted, is known as the Yaryan evaporator. It is manufactured by the Mirrlees, Watson, and Yaryan Company, Limited, and is extensively used in all parts of the world for distilling water. It is illustrated in Fig. 4, and its characteristic feature consists in film evaporation. The principle, which is the same as used in the triple effect just described, will be better understood by reference to Fig. 5, which represents diagrammatically a section through one of the effects. The action is as follows:—

The water to be distilled and to be afterwards used for making ice is admitted to the inside of the tubes through the pipes A. Live steam or the vapour from the preceding effect is admitted through the opening B, and plays round the tubes. As soon as the liquid, which is already nearly boiling, enters the tubes, it begins to boil, and, feeling the influence of the vacuum, it follows the course indicated by the arrows and continues to absorb heat until, finally becoming a mass of spray, it rushes through the tubes and impinges on the metal plates which cause the water to separate from the vapour; the former, falling to the bottom, runs off through the opening C, to be further evaporated in the next effect; the latter passes away through the opening D to expend its latent heat in boiling in a greater degree of vacuum in the next effect the water from which it has just been evaporated. The condensed steam or vapour from the effect is withdrawn through the pipe E. This process continues throughout the six effects, the degree of vacuum in each depending upon the number.

The feed-water is heated on the "step-up" principle. In the first instance, if the water is clean enough it is taken warm from the circulating water of the condenser. It is then exposed to the vapour of the last effect while this is passing to the condenser, and then to the vapour of the several effects constituting the apparatus until, just before entering the first effect, it is brought to the boiling point of that effect by the live steam heating it.

A sextuple effect with a pressure of 40 lb. of steam in its first effect and a vacuum of 27in. in its condenser is capable of producing 4½ lb. of pure distilled water for ever pound of live steam used in the first effect, but owing to live steam being a necessity its application is limited in ice factories where ample exhaust steam is usually available. The production of the various sizes is approximately as follows, the primary steam being in all cases returned to the boiler as feed-water:—

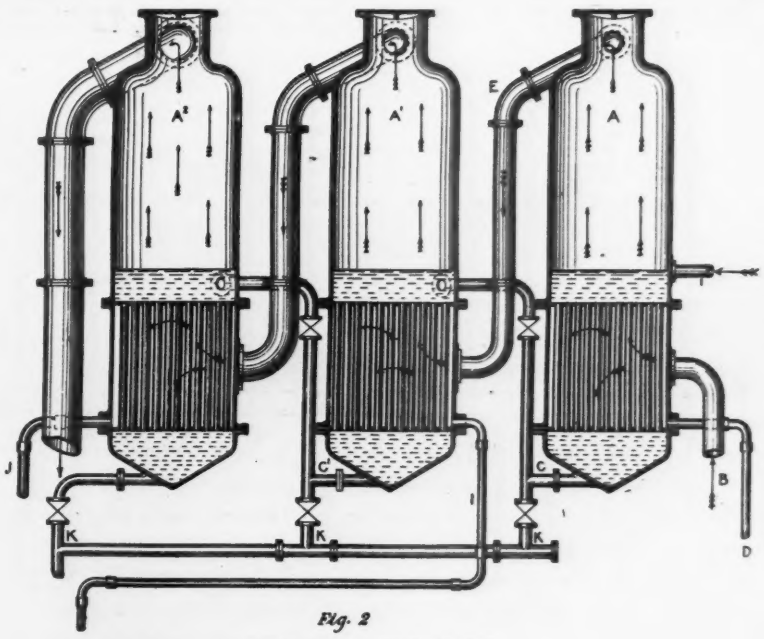


Fig. 2

TRIPLE EFFET EVAPCRATCR

	Distilled water per lb. of steam. lb.
Double effect	1½
Triple effect	2½
Quadruple effect	3
Quintuple effect	3½
Sextuple effect	4½

It must be remembered that water produced by this means is ready for making clear pure ice without any further treatment, except, perhaps, that of passing it through a Pasteur filter. Sometimes it is re-boiled to rid it of any air or permanent gas it may still have in it, but this is not usual. In any case the net result is that with a triple effect 2½ lb., and a sextuple effect 4½ lb., of pure distilled water, free from all pathological microbes and ready for making pure clear ice, are obtained for every pound of boiler steam fed into the apparatus or—in the latter case and

* Paper read at the meeting of the Cold Storage and Ice Association, on November 7th, 1900.

assuming the evaporative efficiency of the boiler and coal to be only 8 lb. of water to a pound of coal—36 lb. of water per pound of coal.

Having now described the various apparatus that are or might be used in producing pure distilled water for ice-making, it will be interesting to go into the question of the cost of the plant for producing it, for it is useless to recommend an article unless it can be clearly shown that money or its equivalent can be saved by its use.

In most towns pure water can be bought at the rate of 6d. per 1000 gallons, or 1¼d. per ton, so that when ice is only wanted to be cold, and there is no objection to its being opaque, it obviously will not pay to distil the water. But, granting that it has been decided for various reasons that pure hygienic ice should be used, the only question to be solved is—What is the cheapest and best method of producing it, taking the coal first and considering labour, interest, and depreciation afterwards?

Four apparatus have been described:—No. 1, that shown in Fig. 1. No. 2, that shown in Fig. 2. No. 3, similar in principle to No. 2, but working with live steam. No. 4, the sextuple-effect evaporator.

Let us now take a hypothetical case of a plant making 50 tons of ice per twenty-four hours, and apply each method to it, allowing throughout that 100 indicated horse-power is required.

With No. 1 apparatus.—We have a 100 horse-power engine working under a back pressure of 5 lb. per square inch; 35 lb. of steam per indicated horse-power hour will under these conditions be a fair estimate of its consumption. This will represent 37·5 tons of steam per twenty-four hours as the engine exhaust. Thus we have:—

	Tons.
Exhaust from engine	37·5
Balance to be made up by condensing live steam	12·5
Total	50 tons evaporated,

which at 8 lb. = 6·25 tons of coal, which, taken at 10s., would make the total steam used by the plant cost £3 2s. 6d.

NOTE.—In practice more than 50 tons will have to be evaporated to make up for loss in filtration, skimming, &c., further increasing the cost.

With No. 2 apparatus.—The engine is still working under a back pressure of 5 lb., and using, say, 35 lb. of steam per indicated horse-power hour, or 37·5 tons per twenty-four hours. But this steam is being exhausted into the first effect of a 2½ to 1 triple effect, so that the 37·5 tons would produce, say, 94 tons of distilled water, or nearly twice as much as is wanted. Consequently the evaporator will only have to work thirteen hours per day, the engines exhausting to atmosphere the rest of the time, and so working at a better efficiency—or an evaporator of half the size and working for the twenty-four hours may be used. Thus we have:—

The engine working for 13 hours at 35 lb.	= 20·3 tons
,, ,, 11 ,, 30 lb.	= 14·7 ,,
Total steam used by engine	35·0 ,,

The 20 tons used in the thirteen hours will produce in the triple effect 50 tons of distilled water. So that the total steam used by the plant is 35 tons, requiring 4·37 tons of coal, and costing £2 4s. per twenty-four hours.

With No. 3 apparatus.—The 100 indicated horse-power engine is working to a condenser, and so is only using 25 lb. of steam per indicated horse-power hour, or 26·78 tons per twenty-four hours. But the steam for the evaporator is in addition to this, and 50 tons have to be evaporated in the apparatus at 2½ to 1, which will require 20 tons live steam. Thus we have:—

	Tons.
Steam used in the engine, say	26·5
Steam used in evaporator, say	20
Total steam used	46·5 tons,

requiring 5·8 tons of coal, and costing £2 18s. per twenty-four hours.

With No. 4 apparatus.—The 100 indicated horse-power engine is worked to a condenser, and is only using 25 lb. of steam per indicated horse-power hour, or, say, 26·5 tons per twenty-four hours. But the steam for the sextuple effect is in addition to this, and 50 tons have to be evaporated in the apparatus at 4½ to 1, which will require 11 tons of live steam. Thus we have:—

	Tons.
Steam used for engine, say	26·5
Steam used for evaporator	11
Total steam used	37·5

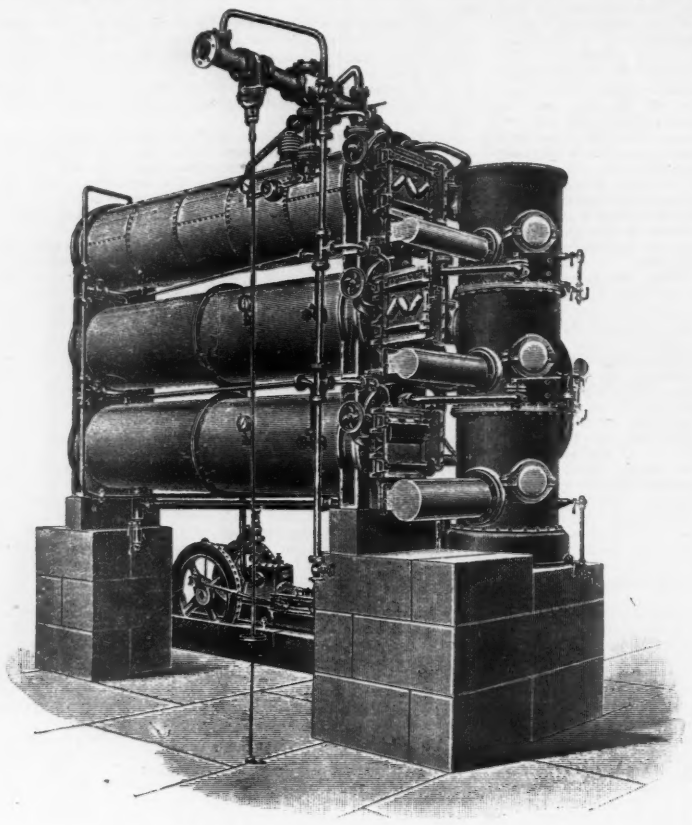


Fig. 3—LIVE STEAM TRIPLE EFFET EVAPORATOR

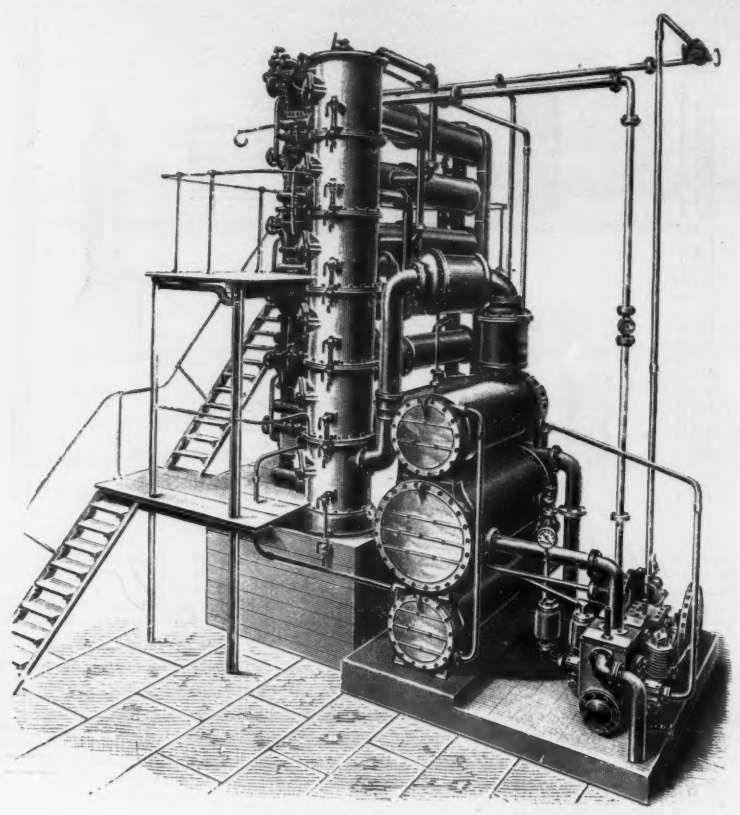


Fig. 4—YARYAN EVAPORATOR

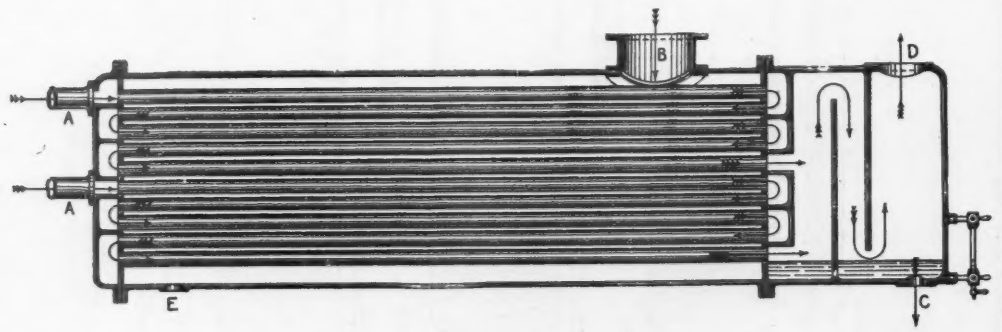


Fig. 5—ONE SECTION OF EVAPORATOR

or, say, 4·7 tons of coal, costing £2 8s. per twenty-four hours. To summarise:—

	£.	s.	d.
No. 1 plant costs in coal per twenty-four hours	3	2	6
No. 2 ,, ,, ,, ,, ...	2	4	0
No. 3 ,, ,, ,, ,, ...	2	18	0
No. 4 ,, ,, ,, ,, ...	2	8	0

Here we may leave No. 1, for in dealing with this item it is necessary to generalise largely, as no reliable data exist as to its cost of installation, the exact practice and the apparatus employed varying largely with the will of the designer of each installation. It must be remembered, however, that though the first cost of the plant is probably low, there is a constant charge for filtering material and for labour, the attention required being so much greater than in the other systems, while, as has been pointed out, any attempt to economise in these two items is liable to give the ice a bad taste, and so spoil a freezing. The system, however, has been largely used in the States, and in some cases in England; and, although the risk of getting impure ice is greater than with the other systems, there is no doubt that, where care and attention has been given to the cleanliness of the various vessels, its use has been attended with success. No. 3 system has already been commented upon, and its advantages and limitations pointed out. With regard to No. 2, the most serious disadvantages are the first cost and the back pressure on the engines, and consequent danger of getting water in the cylinders. Where exhaust steam can be obtained in ample quantities, and there is no objection to working the engines with a back pressure, its economy is most marked. Taking, for instance, the hypothetical example before referred to, the cost in coal by this system was £2 4s. per twenty-four hours, or, assuming the plant to be working full power for only six months in the year, say £401. The first cost of the apparatus would be about £1750; allowing 10 per cent. for interest and depreciation, the total annual cost would be £576. System No. 1 costs £3 2s. 6d. per twenty-four hours, or for the six months £570.

Assuming that interest and depreciation, filtering material, and extra labour, would cost for system No. 1 £200, the total annual cost would be, say, £770, showing a saving for No. 2 of £194 per annum. In the above the triple effect is only working thirteen hours out of the twenty-four, if a smaller size were installed and allowed to work the twenty-four hours round it is easy to see that, as the first cost would be less, the saving would be greater. It must, however, be borne in mind that in a modern ice factory of any size the refrigerating machines are frequently required to deal not only with the ice tanks, but with cold storage as well, and there are also electric lighting and power machinery, pumping machinery, and possibly air compressors, and other auxiliary machinery. In fact, the power used in ice-making bears a comparatively small proportion to the whole power generated. There are obvious difficulties in splitting the exhaust steam supply and working some of the engines under a back pressure to supply the distiller, and some condensing, and as it is out of the question from an economical point of view to run the whole plant under a back pressure for the sake of utilising a small portion of the exhaust steam in the distilling apparatus, it may be desirable to exhaust the whole of the engines to a surface condenser and have the distilling plant entirely separate and self-contained. In this case a live steam triple effect or a sextuple effect would probably be the best plant to instal.

For instance, the first cost of a 50-ton sextuple effect working with live steam is about £1800. Allowing 10 per cent. for interest and depreciation, this would represent £180 per annum. It costs in steam £2 8s. per twenty-four hours, or for six months £438, making a total of £618, which is only £42 more than No. 2.

It will be easy for anyone interested in the matter to work out for themselves from the figures given the cost per ton of distilled water. When this is done it will be quite likely that they will say, "Our water analysis is good, and the public seem very well satisfied with ice as we make it, and therefore we will not go to the expense of putting down a distilling plant." There are many people who think in this way, and to these the author would point out that quite apart from the question of purity and the other advantages already given, distilling apparatus may be made to pay for itself and cheapen the cost of production by quickening the rate of freezing, so increasing the output from any given plant. The manager of a cell, plate, or can system freezes slowly and at as high a temperature as practicable in order to let the air in the water escape and thus produce clear ice, but it is obvious that if there is no air in the water to make the ice opaque there is no necessity for these precautions, and that therefore the water may be frozen at a much lower temperature, and consequently much more quickly, and the ice will still be clear. This is the outward and visible sign of the economy of using distilled water, and can be appreciated by anyone. Other advantages which have been dwelt on are equally potent, but perhaps not so easily appreciated.

The various ways of producing the distilled water have been pointed out in the paper, but every case must be considered on its own merits, for conditions that exist and govern a decision in one instance may be, and often are, entirely absent in another. At the same time it would appear to be a fact that many ice factories waste much more coal than there is any necessity for; there is now no occasion for any engine to work non-condensing, and, although practice is better than it used to be, there is great room for improvement, and the author hopes that the efforts he had made to point out the direction in one branch alone in which economies may be practised, will prove of use to those who are striving as all men should, to produce the best possible article at the least possible cost, and that ice manufacturers will realise the ordinary commercial advantage of placing upon the market an article of crystal purity and capable of being guaranteed, so that ice may be used with absolute confidence by all.

IN the village of Simmoyheim, in Wurtemberg, a new oil-lighting system has been installed. The system is described as follows:—From a large central petroleum reservoir, the oil from which the light is produced is distributed by copper piping to the different lamps, where the petroleum is vaporised by a special apparatus and burner. The light is said to be very brilliant and steady, and, as a very limited quantity of oil is used, the cost is slight. The royal Wurtemberg railroads have just concluded a contract with the company to put in a plant, according to this system, at the Cannstadter railroad shops at Stutgart.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

THE year which is just closing must be pronounced a disappointing one in the iron trade of this part of the kingdom. The high expectations with which it opened have scarcely been fulfilled, and though employment has continued abundant, prices during the last six or eight months have steadily fallen. In addition to this ironmasters have had to contend with abnormally high prices for both coal and cokes and other raw materials.

Staffordshire marked bars which at the end of 1899 were at £10 10s., started the year at £11, being advanced 10s. on the prices which ruled in 1899, with the commencement of January. A second 10s. was added a month later, but owing to the lead given by the Unmarked Bar Association in reducing prices, and to the increase of American and Belgian competition in the export markets which was robbing Staffordshire makers of orders, both these advances were withdrawn two months ago, and the policy was a wise one. To have kept prices on an artificial basis in face of the falling off in orders which had appeared would only have been to play into the hands of the foreigner.

Common bars, as controlled by the Unmarked Bar Makers' Association, have not played so prominent a part this year as last. It is true the association has been active, and has even been the means of forming a sort of national association or committee which professes to regulate or take note of common bar prices the kingdom over. But success has not attended the well-intentioned efforts of the association to keep up prices as it did in 1899. £10 was the association figure when the present year started, and the maximum was touched at £10 15s. early in April. At the commencement of October, however, a reduction of £1 was declared, and, as a matter of fact, the figure had been merely a nominal one for some time previously. The 20s. reduction by no means, too, represents the actual state of affairs to-day. On the open market scarcely more than £8 can be got as the year closes, and some sales are even recorded at £7 15s. Thus the association declarations have not followed the market down as they went up.

Hoops have seen a drop on the twelvemonth of £1 10s. to £1 15s. per ton, the £10 10s. of January having now become £9 to £9 5s., and nail rods and rivet iron have fallen in like proportion, to-day's price being £8 10s. to £9 per ton.

The sheet iron trade has passed through another unsatisfactory year—how unsatisfactory is seen in the troubles which are now dominant. Demand all the year has been much within the capacity of the mills, and to make matters worse there has been little relaxation of the competition which for some time past has been the trouble of this trade from Lancashire, the Deeside, South Wales, and even the North of England. One of the main causes of the insufficient demand has been the war in South Africa, which has almost paralysed the operations of some of the galvanisers who are the chief buyers. In January sheets were quoted £10 10s. to £11 for 24 W.G., and they close the year at £8 10s., or a drop of £2 to £2 10s. Galvanised corrugated sheets started 1900 at £15 f.o.b. Liverpool, and they are now £12 to £12 10s.—a drop, it will be seen, of £2 10s. to £3 per ton.

Pig iron makers alike at the Staffordshire and Midland furnaces have not experienced so satisfactory a year as in 1899. Nevertheless, considerable profits must have been made. The chief drawback has been the notoriously high price of cokes and coal which has eaten up profits and made high contract prices, for pigs sometimes wear a very different list to when viewed in the aspect of actual return to the producers. During the last three or four months of the year there has been a steady reduction of make brought about, and the blowing out of furnaces occasioned by the lessened demand, and the inability of furnace owners to reconcile the maintenance of high fuel rates with the fall which, since April, has been going on in raw iron so long.

Northampton, Leicestershire, and some similar brands of forge pig iron opened the year at 73s. per ton. At the April quarterly meetings the price had advanced to 75s. and 77s. 6d., while Derbyshires were quoted 76s. to 78s., and North Staffordshire 77s. to 79s. These were the highest prices touched during the twelvemonth. At the July quarterly meetings quotations had got down to 70s. to 72s. 6d., and occasionally 70s. for Northamptons and Leicestershires, and 71s. to 76s. for Derbyshires. Since then the decline has continued, until the end of the year finds Northampton and Leicestershire quoted 55s. to 60s., Derbyshires 56s. to 61s., and North Staffordshire forge pigs 57s. 6d. to 62s. 6d. Thus there has been a drop to date from the maximum of 20s. to 22s. 6in. in these classes of pigs. Two years ago to date Northampton forge pigs were changing hands at 45s. per ton.

South Staffordshire pig irons in January were quoted: Forge pigs, 70s.; part-mines, 75s.; all-mines, 77s. 6d.; and best ditto, 90s. By April, cinder pigs had advanced to 72s. 6d. to 75s.; part-mines, 75s. to 77s. 6d.; all-mines, 77s. 6d. to 82s. 6d.; and best all-mines, 90s. to 100s. To-day values have fallen to: Forge pigs, 57s. 6d. to 60s.; part-mines, 60s. to 65s.; all-mines, 62s. 6d. to 75s.; and best ditto, 90s. to 95s. The reduction from the maximum in Staffordshire metal has therefore been 15s. 6d. on common and all-mine pigs alike. At the close of 1898, or just two years ago, Staffordshire cinder pigs were selling at 45s. per ton; part-mines, 48s.; all-mines, 56s.; and best ditto, 66s.

American pig iron competition has not exercised this market so much as several others of the leading centres of the kingdom, and its influence has been less directly felt. Still purchases of both American foundry and forge irons have been going on, and this buying has been a lever which consumers have made the most of in their dealings with both Midland and Staffordshire makers, and the circumstance that American iron was coming into the country has induced a certain degree of caution on the part of native sellers. The difficulty of buyers, however, has always been their inability to get anything like prompt supplies of the American iron, and to secure uniformity of composition.

The steelmakers have, upon the whole, borne themselves with more even front throughout the year than ironmasters, though during the last four or five months there has been a good deal of easing off both in demand and prices. The works have, however, mostly been fully employed. American competition in steel has been rather more pronounced in this district than in pig iron. Billets and tin bars for rolling down purposes have been the forms in which the American material has been chiefly coming in to Staffordshire, though constructional and wagon-building material—such as bars, angles, and plates—have not been wholly wanting.

Bessemer blooms and billets last January were quoted £7 5s.; Siemens, £7 10s.; rolled merchant bars, £8 15s.; engineering and bridge plates, £9 5s.; and girders and angles, £8 15s. The end of the twelvemonth finds billets £5 10s. to £5 15s.; best Siemens ditto, £5 15s. to £6; merchant bars, £8 5s. to £8 15s.; plates, £8 to £8 10s.; and angles and girders, £8 to £8 5s. These figures show a decline in billets of 30s. to 35s.; plates, 15s. to 25s.; and girders and angles, 10s. to 15s. per ton.

Coal is down about 2s. per ton as the year ends, compared with the top boom prices for ironworks fuel of some two months ago. When at the maximum, fuel was selling at higher prices than for nearly thirty years previously. It closes 1900 at 15s. to 16s. per ton for ironworks sorts, and 8s. to 10s. per ton for slack, while furnace cokes are 20s., and foundry sorts 27s. per ton.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—With no iron 'Change meeting held in Manchester since Friday, and really little or no business passing through beyond small parcels imperatively required, or here and there speculative operations for next year at excessively low-cut prices, quotations can only be regarded for the present as little more than nominal. For Lancashire pig iron makers' basis rates remain nominally unchanged, but Lincolnshire makers have further reduced their list prices 2s. per ton, bringing No. 3 foundry to 57s. 6d. net cash. Forge Lincolnshire has also been reduced to the same extent as foundry qualities, 57s. 2d. net being now the list basis for delivery Warrington, with Lancashire nominally about 60s., less 2½, and Derbyshire about 59s. net. For Middlesbrough iron there are sellers in the market at 60s. 4d., with makers quoting 62s. 10d. to 63s. 4d. net by rail Manchester. Scotch iron is quoted about 71s. for Eglinton and Glengarnock, and American foundry about 63s. net Manchester docks.

In the finished iron trade makers' list basis rates remain nominally unchanged until after the turn of the year, on the basis of £8 for Lancashire, and £8 to £8 5s. for North Staffordshire bars, but there are anticipations that these will have to be reduced, and in the meantime merchants are prepared to sell at about £7 15s. delivered Manchester district. Hoops and sheets are nominally about as last quoted.

Prices in the steel trade are irregular, but any quotations are scarcely more than nominal, as there is little or no business being put through. Local-made billets remain at about £5 10s.; steel bars and common steel plates range from £7 per ton upwards, and £8 would seem to be the full average figure for steel boiler plates, with makers in some instances open to offers even below this figure.

The fairly long spell of exceptional activity throughout practically all branches of the engineering industry, extending over the last four or five years, has for the most part been fairly well maintained during the past twelve months; but with the close of the year the position outside one or two sections is not altogether very encouraging with regard to prospects for the immediate future. Taking the employment returns of the leading engineering trade unions as a fairly good index, these show, except that towards the close of the year there have been evidences of lessening demand for labour, no slackening of industrial activity generally during the greater portion of the past twelve months. The Amalgamated Society of Engineers, which commenced with about 2 per cent. of the membership in receipt of out-of-work support, has been able to show a diminished unemployed list, 1½ per cent. representing the average over a considerable period. The Steam Engine Makers' Society, which has returned an almost continuous donation list of not more than ½ per cent. of its membership, with practically a clear book in many of the important Lancashire centres. The United Machine Workers' Association has also practically during the greater portion of the year averaged from 1½ to 2 per cent. of the membership in receipt of out-of-work support. With, however, all these undoubted indications of exceptional activity, the position has not been altogether so satisfactory as it would appear on the surface, and in some important branches it has been rather a pressure of work that had been accumulating previously than of really new orders coming forward.

The two important sections of engineering that have stood out prominently as altogether unaffected by the undoubted tendency towards slackening off in the near future that has been noticeable in other directions are the locomotive and general railway plant-building trades, and all departments of electrical engineering. Early in the year a large weight of work was coming forward for locomotives and railway stock generally, and a number of Lancashire firms had orders on their books to keep them fully engaged for a considerable time ahead. During June there were further large inquiries from the railway companies, and then again towards the close of the year the home and colonial railway companies were once more on the market with inquiries for locomotives and rolling plant generally, far in excess of what builders could entertain for anything like early delivery, most of them being fully booked over the whole of the following year. The enormous progress going on in the utilisation of electricity for motive power in works, for traction purposes, on tramways and railways, and for lighting, has necessarily given an unprecedented stimulus to all branches of electrical engineering, and works have not been able to meet in anything like satisfactory fashion the requirements of their customers, whilst the extreme pressure of orders seems more likely to increase than otherwise, and there are very few firms that have not more than sufficient work to carry them over the ensuing year.

Apart from these special branches of trade, the outlook is unquestionably less satisfactory than it has been, and the high cost of production has undoubtedly tended to restrict new operations. This has been particularly noticeable in structural undertakings requiring a large weight of material. Machine tool makers, who have generally been fully engaged all through the year, are in the position that they are running off orders more rapidly than these are being replaced, and here also the question of cost has entered, although to a much more limited extent. Amongst heavy stationary engine builders business has been steadily on the decline, but in the smaller type of engines, and especially those suitable for electrical requirements, activity has been fully maintained. The boiler-making trade, although never actually slack, has fluctuated somewhat, and here the high price of material has no doubt considerably influenced the placing out of new orders, but with steel plates rapidly getting back to something like old rates, there may possibly be less hesitation in carrying out renewals and necessary enlargements of steam plant.

The shipbuilding trade on the Mersey, once an important centre of this branch of industry, is now almost solely represented by Laird Brothers, Limited, of Birkenhead. They report, however, that during 1900 they have had a large weight of work passing through the shops, and the following vessels have been launched from the yard:—H.M.S. Mutine, steel single-screw, 600 tons gross, 1400 indicated horse-power, 13½ knots; H.M.S. Rinaldo, steel single-screw, 600 tons, 1400 indicated horse-power, 13½ knots; H.M.S. Lively, steel twin-screw, 320 tons, 6250 indicated horse-power, 30 knots; H.M.S. Sprightly, steel twin-screw, 320 tons, 6250 indicated horse-power, 30 knots; H.M.S. South Stack, steel twin-screw, 1065 tons, 2750 indicated horse-power, 16 knots; Campos Salles—foreign—steel twin-screw, 900 tons, 1300 indicated horse-power, 13 knots; and Justo Chermont—foreign—steel twin-screw, 900 tons, 1300 indicated horse-power. In addition to vessels launched the company have turned out a large amount of engineering work during the year. The machinery of H.M.S. Implacable, of 15,000 indicated horse-power, has been fitted on board at Devonport, and is now ready for trial, whilst machinery of 18,000 horse-power for H.M.S. Montagu is in a forward state in the shops.

As a rule collieries in this district have been kept fairly busy up to the holiday stoppages of the pits, and prices remain generally strong at recent quotations. With the holidays now set in, however, business may be regarded as practically closed until the turn of the year.

Barrow.—During the past week there has been no great change in the condition of the hematite pig iron trade. There is only a rather small demand for iron, and the Barrow Hematite Steel Company has found it necessary to blow out one of their furnaces. This brings the total number of furnaces in blast in the district down to thirty-six—a much lower number than for some time past. There is no disposition on the part of consumers to place orders of any great bulk, as there is a feeling that before long there will be a big drop in values. At present makers are quoting 70s. to 72s. 6d. per ton net f.o.b. for parcels of mixed numbers of Bessemer iron. Warrants are at 65s. 8d. per ton sellers, with buyers offering 6d. less. The prospects for the New Year are not over bright. Makers are fairly well off for orders. The stores of warrant iron stand at about 22,000 tons.

The steel trade, during this week, is almost wholly closed down on account of the Christmas holidays. At Barrow all the mills are stopped. The orders held represent a fair tonnage of steel, but there is not a great deal of new business offering in some branches of the trade. Steel shipbuilding material is not finding a big demand at present. Steel ship plates are at £7 10s. per ton and boiler plates are at £8 5s. per ton. For steel rails there is a fair demand, but the competition is very great in the rail trade. Heavy sections are at £6 to £6 10s. Light rails are at £7 10s. per ton. Hoops are at £11 10s., and represent a good trade.

The demand for hematite iron ore is very good. On local account the consumption continues to be as much as raisers can cope with, and on general shipping account the demand for the best sorts is brisk. Prices are firm. Good average sorts are at 15s. 6d. to 17s. 6d., and the best classes of ore are at 22s. per ton. Spanish ores are being imported at 18s. to 19s. per ton. Delivered coal and coke are in big request.

The engineering and shipbuilding trades are observing the Christmas holidays. No new orders are to hand.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

CHRISTMAS is practically a blank week in all departments of South Yorkshire trade. Prior to the holidays a good deal of extra work was done in the coalfield, with a view to providing supplies over the "play" time. Although in several instances the output was exceptionally large, the rule was quite the other way, several of the collieries working only a part of the week, and even that short employment resulted in a considerable quantity being put to stock. The question of railway contracts has not been definitely settled by the coalowners offering to give supplies at 14s. per ton. The railway managers are still holding off in the hope of getting better terms. Until this matter is decided, railway companies seem disposed to buy what they want in the open market, and thus the coal trade generally will remain in a state of uncertainty. Once the large railway contracts are arranged, business will take a firmer basis, and the lesser buyers come freely forward. At the same time, there is not likely to be a repetition of the old weakness in coalowning circles, upon which general managers usually depend. If it is true, as is freely stated, that several of the railway companies have agreed to pay 13s. 6d. per ton for Derbyshire coal, they ought not to "boggle" at 14s. a ton for South Yorkshire coal, which usually commands 1s. per ton more than that of Derbyshire.

In house coal local consumers very naturally complain that whilst values are lower elsewhere, they are paying now as much as they did when coal touched its highest price. Merchants say they cannot help themselves, as coalowners decline to make concessions. Trade in household sorts is quiet all round, largely owing to the abnormally mild weather. Quotations remain practically unaltered, except for large transactions, for which easier rates prevail. Best Silkstones make 15s. to 16s. per ton, Barnsley house 14s. to 15s. per ton.

Steam coal continues to be freely delivered on contract account for railways and inland requirements, the call for the iron trade, however, being considerably weaker. Considering the season, the export trade is fairly well maintained, quotations still keeping at 15s. to 16s. per ton for best Barnsley hard coal. The tendency, if anything, is towards lower prices. The gas companies are not so urgent as they were, and deliveries are being made almost exclusively on contract account. A little more briskness is perceptible in engine fuel, but supplies being abundant, values remain uninfluenced; nuts, 9s. 6d. to 10s. 6d. per ton; screened slack from 7s. 6d. per ton; and pit slack 1s. a ton cheaper. In the coke trade there is no improvement to report, values still falling, and consumers giving every indication of still further attenuating requirements.

The development of new coalfields in South Yorkshire promises to be carried on most energetically during the new year. The railway from Old Roundwood Colliery to New Dalton Colliery is almost completed. Energetic preparations are in progress to open up the valuable coalfield lying between Rotherham, Shireoaks, Maltby, and Conisborough. There is a growing conviction amongst those conversant with the possibilities of the district that light railways would not be able to cope with the enormous traffic which is certain to be developed in a few years' time. That view has been brought vigorously before the North-Eastern and Hull and Barnsley companies, the directors of which, it is understood, have decided to lay down a permanent railway. Surveys are at present being made for a new line, promoted by private enterprise, to connect these two railways with Rotherham.

The values of iron have fluctuated considerably during the year, but have not afforded such striking contrast as in previous years. On January 1st hematite pig iron, West Coast, stood at 93s. 6d. per ton; on April 1st at 97s.; on July 1st it had dropped a shilling to 96s.; and on October 1st to 92s. 6d. Then came a period of sharper declension, the price when the large works set down for the Christmas holidays being 82s. 6d. In 1899 the values for the corresponding periods were respectively 67s. 6d., 69s., 73s., 86s., 93s. 6d. In 1898 the prices began at 59s. per ton, rose in April to 59s. 6d., in July to 61s., in October to 64s., and in December to 66s. It will thus be seen that the course of the hematite pig iron market in 1899 and 1898 was from a low price to a high one, while in the year which is now closing it has been steadily falling from a high price to a low one. North-East Coast irons, it should be mentioned, are about 2s. per ton less than these prices.

Coming to common forge iron we find that in January the price was 70s. per ton, which was maintained up to well beyond April, but on the 1st July it fell to 68s., in October to 60s. 6d.; and in December to 57s. 6d. In 1899 the price in January was 46s. 6d.; in April it had risen to 48s.; in July to 62s. 6d.; in October to 68s. 6d.; and in December to 72s. 6d. It will thus be seen that the top price of forge iron last year was 2s. 6d. less than the top price realised in 1899. During 1898 the highest price obtained for this class of iron was 45s. 6d., which was the closing rate of the year, the opening price having been 41s., while the value went slowly up quarter by quarter until 45s. 6d. was obtained at the close of the year.

The "boom" in the steel trade spent itself early in the autumn. On January 1st Bessemer billets were £9 per ton and Siemens steel £9 10s. In April the price was £10 for Bessemer billets, and £11 10s. for Siemens. The close of the year finds Bessemer down to £9 and Siemens to £10 per ton. There has been full employment for the large part of the year, but there are fewer orders on the books for the next. A very distinct decline is noted in crucible steel. The outlook in this and other directions is not encouraging; but considerable relief is reported from cheaper coal, which has greatly handicapped the iron and steel trades during the twelve months.

The demand for guns has been incessant during the year, and Vickers, Sons, and Maxim, Limited, the only firm here who make guns outright, are fully occupied in all departments concerned in field artillery and ships' guns; other firms who make the tubes, gun jackets, &c., are also busy. Manufacturers of armour-piercing projectiles and the various descriptions of shot and shell have been actively engaged during the whole year, and 1900 closes with full body for 1901. Very great extensions in all the military material departments have taken place within the last twelve months, and there is work for all the plant in this district and outside it.

In the lighter departments of Sheffield industry the year has not been quite so good as was anticipated at the outset, and the protracted war in South Africa has told severely against the Christmas and New Year season demands. A good deal of work in engineering, mill, mining, and similar specialities is being got ready for the re-opening of the Transvaal and Orange River Colony to business.

All the works engaged upon colliery specialities have had a prosperous time, but marine and railway material has latterly fallen away somewhat, and the prospects for the new year are not so favourable as at the corresponding period of last year.

NORTH OF ENGLAND.

(From our own Correspondent.)

This being a holiday week, business is quiet, but is not more so than it has been hitherto this month. It is satisfactory, however, to be able to state that the rapid decline in prices which has been going on in the pig iron trade for over three months has been checked, and the reductions to be reported this week are not in extent anything like those that have had to be recorded of late; in fact, there is less fall in the week than has sometimes been made in a single day. It was time, however, the sellers made a stand, the producers especially, as pig iron was coming down faster than the cost of materials, and therefore of production, and they have arrived at rates which will not cover cost even with well-situated firms. It is noteworthy, as it is almost unprecedented, that the prices of pig iron since the middle of September have shown one unbroken fall, not on any day has there been the slightest recovery, and seldom indeed have the quotations stood even for two or three days at the same. Every change, in fact, has been in a downward direction. The situation thus became serious for ironmasters, they were making considerably more iron than the market needed, and stocks were increasing at a rapid rate at a time when only iron at unprofitable prices could be added to the stocks, and when, if the output continued to exceed the requirements, the value of iron would decline still more, and the loss increase likewise. It could not be expected that cost would decrease if the consumption of materials were kept up.

The ironmasters have adopted unusual steps in order to bring about changes in their favour—checking the downward movement in prices, and accelerating that in the value of materials; in fact, they have determined to reduce output to the level of demand, so that they need not accumulate stocks. They will not again hold heavy stocks, especially when they would have to lay them down at prices which could hardly prove otherwise than unprofitable. The step they have taken, as they cannot do anything to increase demand, is to reduce production by blowing out or damping down some of their furnaces. Every furnace that needs relining or extensive repairs is being stopped, and so far this month 12 have been stopped, making 15 for this quarter, and to-day, out of 123 furnaces built in the North of England, 82 are in operation, against 97 at the commencement of the quarter. Of these 15 furnaces stopped, eight are blown out, and seven damped down, while seven were making Cleveland ordinary iron, and eight hematite or basic iron.

The firms stopping furnaces this quarter are all in the Middlesbrough district, and are as follow:—Sir B. Samuelson and Co., four; Cargo Fleet Iron Company, two; Bolckow, Vaughan, and Co., four; Edward Williams, two; Wilsons, Pease, and Co., one; North-Eastern Steel Company at Acklam Works, one; Gjers, Mills, and Co., one. More will be damped down if necessary. The action now being taken is similar to that of 1886, when the production was reduced by 20 per cent., but then the step was taken by concerted action, a definite arrangement being made among the ironmasters, now each is taking his own course. The situation is not so bad as it was then, seeing that in 1886 over 650,000 tons of pig iron was in stock in this district, now 100,000 tons will be the outside. But makers do not intend to allow themselves to get into anything like so bad a position if they can help it, and will not throw away the good profits of the past few years by continuing to work at a loss.

It is believed that the reduction of production now more than counterbalances the increase that has been going on in the stocks, for the rate at which pig iron is being made now is at the rate of 40,000 tons per month less than it was at the commencement of the month. This action, coupled with that taken by the Scotch ironmasters, and also by those on the West Coast, must bring down the price of coke and other materials, and wages will have to come down where they are not regulated by automatic sliding scales.

At Middleton Ironworks, Fighting Cocks, near Darlington, which have been idle for over fifteen years, one of the four blast furnaces will be blown in next month for the production of ferromanganese.

The price of No. 3 Cleveland G.M.B. pig iron has this week been steady at 52s. 6d. per ton for prompt f.o.b. delivery, this being the lowest figure that has been reported for it since April, 1899, and it is 27s. per ton less than the best price of the year. Little, however, has been sold this week. Makers are not much disposed to sell iron just now, they want to wait in order to see the result of their new departure. No. 4 foundry is at 51s. 6d., and grey forge at 51s. Mixed numbers of East Coast hematite pig iron have ceased to fall, as they have for more than a fortnight been kept at 70s., which is only 17s. 6d. below the best figure of the year, and thus the value has not declined anything like so much as that of ordinary Cleveland pig iron. Rubio ore is being offered at 17s. 6d. per ton delivered c.i.f. in this district.

A considerable proportion of the finished iron and steel works are idle this week, and some will stop for part of next week also; orders are scarce, and there is not enough on hand to keep the mills fully going, so there is no hurry about restarting. It is almost the same at the engineering and shipbuilding establishments; they generally get three days this week and three days next. Manufacturers have not further reduced their prices, as they are already below cost. The last has been abnormally high all the year, and it is hardly to be expected that producers will be able to declare as good profits as those of last year; indeed, there are cases where scarcely any dividend at all can be looked for by the shareholders, for the greater cost of materials has swallowed up the extra prices that have been obtained for the finished article. Some manufacturers now have contracts on their books which will keep them going only a few weeks. In wages they have had no relief this year; on the contrary, they have been advancing since selling prices began to decline, for they are based upon the realised prices of the iron or steel delivered during particular periods, and not that sold during that time. It is probable that the next ascertainment as regards the realised prices of finished iron will show another advance, with a further rise in wages. This week it has been announced that the wages of the steel millmen at Consett, which are based upon the prices realised by the company for plates during the last quarter, will have their wages advanced 2½ per cent. for the first quarter of next year. The price of common iron bars is £8; best bars, £8 10s.; iron ship plates, £6 12s. 6d.; steel ship plates, £6 15s.; iron and steel ship angles, £6 15s.; steel boiler plates, £9 5s., all less 2½ per cent., f.o.t. Heavy steel rails may be bought at £5 17s. 6d. net at works.

The sudden death is announced this week of Mr. John G. Swan, managing director of the Cargo Fleet Iron Company, Limited, Middlesbrough, and of the Bearpark Coal and Coke Company, who have one of the largest collieries in Durham county. He was born at Walker-on-Tyne in 1839, and commenced his commercial career in the office of Messrs. Bell Brothers at Newcastle, about forty years ago.

The coal trade is quieter that it has been for a long time, partly on account of the holidays and partly because of the slackening of general trade and the smaller consumption of fuel. Prices are easier all round, and consumers hold off in the expectation of buying at still lower prices. The North-Eastern Railway Company has placed nearly all the contracts for its next half year's supply of locomotive coal. It solicited tenders some time ago, but the figures quoted were so much above what the company was prepared to give, that the distribution of the orders was postponed. Now that they have again been offered the customers asked considerably less than their first offers, and the business has been carried through. About 12s. per ton at the pit is that to be be paid, this being about the figure that was paid when the last contracts were made. Best steam coal can be bought at 13s. per ton f.o.b. Good coke is being sold at 17s. 6d. per ton delivered at the furnaces in Teesside.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

There has been very little business doing in the iron and steel trades this week, in consequence of the holidays. The pig iron market was closed from Friday of last week until Thursday this week, and the business done has been almost altogether confined to the requirements of speculators, as there is scarcely any demand on the part of consumers. Scotch warrants are worth about 62s. per ton, and are understood to be rather difficult to obtain. Ordinary Cleveland warrants are quoted 51s. 6d., and Cumberland hematite 65s. cash, these rates showing a decline upon recent figures. Scotch hematite is quoted 77s. 6d. per ton delivered at the steel works.

Since last report one additional furnace has been put on hematite pigs at Shotts, and one on ordinary, and another on hematite at Langloan Ironworks, the total furnaces now in operation in Scotland being eighty-four, compared with eighty-one at this time last year.

There is an impression that prices of warrants may improve to some extent before the close of the year in consequence of the more cheering accounts with reference to the American iron trades and the necessities of the bears, an oversold account being reported as open. Apart from these circumstances, there seems to be nothing in the present conditions of the trade here to justify any hope of active business in the immediate future.

The prices of Scotch makers' pigs are as follows:—Govan at Glasgow, No. 1, 63s. 6d.; No. 3, 62s. 6d.; Monkland, No. 1, not quoted; No. 3, 66s.; Carnbroe, No. 1, 69s. 6d.; No. 3, 66s. 6d.; Clyde, No. 1, 77s.; No. 3, 66s. 6d.; Gartsherrie, No. 1, 77s. 6d.; No. 3, 67s.; Calder, No. 1, 78s.; No. 3, 67s. 6d.; Summerlee, No. 1, 81s.; No. 3, 67s. 6d.; Coltness, No. 1, 83s.; No. 3, 67s. 6d.; Glengarnock at Ardrossan, No. 1, 76s. 6d.; No. 3, 66s. 6d.; Eglinton at Ardrossan or Troon, No. 1, 67s. 6d.; No. 3, 66s.; Dalmellington at Ayr, No. 1, 68s.; No. 3, 66s. 6d.; Shotts at Leith, No. 1, 81s.; No. 3, 69s.; Carron at Grangemouth, No. 1, 78s.; No. 3, 68s. per ton.

The shipments of pig iron from Scottish ports in the past week were small, being only 3797 tons, compared with 5317 in the same week of last year, showing a decrease of 1520 tons. The total shipments since the beginning of the year have been 320,333 tons, an increase of 53,702 tons, compared with those of the preceding year. The imports of North of England pig iron at Grangemouth for the week were 3505 tons, being 3241 tons less than in the corresponding week. Since the beginning of the year these arrivals show a total of 260,145, being 142,815 tons less than in 1899.

The coal trade has been quiet both in the home and export branches. The shipments have been reduced by the very rough weather at sea, and are the smallest of any week this year. The domestic consumption is smaller than is usual at this season, owing to the fact that the weather, though very stormy, is comparatively mild. The total coal shipments in the past week amounted to 174,239 tons, compared with 181,795 in the preceding week, and 177,637 in the corresponding week of 1899. Household coals for home consumption are not much altered in price owing to the difficulty in some cases of obtaining supplies during the holidays. The shipping quotations at Glasgow harbour are, for main coal, 10s. to 10s. 3d.; ell, 12s. to 12s. 6d.; steam, 12s. 3d. to 12s. 9d.; splint, 13s. to 13s. 6d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The predominating feature of the coal trade in Cardiff last week was the rush to get off cargoes before the holiday influences became too marked. Colliers worked well, having their three idle days in view, and to secure as much funds as possible. In proof of the large number of "strangers" now working in the coalfield I hear that from one booking station alone on Saturday 200 men went to North Wales, and the exodus from the colliery towns alone totalled thousands. While the colliers worked full time, owners and shippers were busy at ports. Thirty large steamers left Cardiff and twenty Barry on Saturday. Ten left Newport for foreign destinations, twelve for coastwise, and Swansea, Llanelly, and also the smaller ports were busy. Swansea coal shipments for the week totalled close upon 46,000 tons.

It is currently reported that France now holds a stock of 300,000 tons Welsh coal.

There was a marked stiffness of price in all prompt business. What the quotations will be later on are matters of speculation, but on 'Change, Cardiff, Saturday, there were no fears of a great alteration, at all events for the present. It was the subject of comment that the railways had been able to force down prices a little in the Midlands and the North, and that in this respect Wales was better off, the only weakness of price being in the Swansea direction—a concession much needed to favour the needs of tin-plate manufacturers. The notable shipments of Cardiff on Saturday were four to Genoa, two to Port Said, one to Singapore, ten to France, two to South Africa, and one to St. Helena. Newport shipments were largely to France and Spain, with a large cargo general to the East Indies. Swansea principally to France. Attendance on 'Change at each port was not very marked, the business being chiefly to expedite clearances. It appeared to be a general impression that a blank week was in front, colliers not working scarcely any until the closing days. The latest quotations obtainable, Cardiff, were as follows:—Best steam, 20s., 20s. 6d., 21s.; best ordinaries, 19s.; seconds, from 17s. 6d.; drys, 17s. to 17s. 6d.; best steam, small, 11s. to 11s. 6d.; seconds, 9s. 6d. to 10s. 6d.; drys and inferior sorts, from 8s. 6d.; best Monmouthshire, large, 17s. 6d. to 18s. 6d.; seconds, 16s. 3d. to 16s. 6d.; best house coal, 20s. to 21s.; seconds, 17s. to 18s.; No. 3 Rhondda, 17s. 6d. to 18s. 6d.; brush, 15s. 6d. to 16s.; small, 12s. 6d. to 13s. 6d.; No. 2 in demand, Rhondda, 15s. 9d. to 16s. 3d.; through and through, 13s. to 14s.; small, 8s. to 8s. 6d.

Patent fuel remains at 19s. to 22s., according to brand; furnace coke is selling at 24s. 6d. to 27s.; foundry, 27s. to 30s.; and special foundry, 34s. to 36s. A fine cargo of 2000 tons left for St. Rosalia on Saturday, and over 1000 tons patent fuel.

In pitwood there has been a little droop in prices, consequent upon increased cargoes coming in, and I hear on 'Change that several large steamers are expected, which, with consignments of Irish wood, may keep prices low. Latest figures are 17s. 6d. to 18s. ex ship, Cardiff and Newport, Mon.

Iron ore has been coming in freely to all ports, though the storms in the Channel have interfered and have been attended with disaster and loss of life. The tendency of price is to lower figures. At present quotations, Cardiff and Newport, are 17s. 3d. to 17s. 6d. A slightly better price at Swansea.

On and after the 1st of January, 1901, the Dowlais Company will be carried on as Guest, Keen, and Co., Limited.

At the close of last week 500 tons rails and fish-plates were sent from Newport, Mon., to Bilbao, and two consignments of steel billets came in, 504 tons for the Pontypool Iron Company, and 508 tons for the Pontnewydd Company from Montreal.

No iron and steel quotations have been issued this week up to date of my despatch, but it is understood that the latest on Saturday remains, which practically are the closing ones given in my last report. Orders in hematite pig have fallen. It is reported that big orders for plates have gone to America, and that colonial orders for rails are likely to go as well, but in face of the strenuous efforts of Welsh ironmasters, I do not think this likely. A fair amount of business continues to be done. It is evident, however, that the new year is to bring in changes, and that wages generally will be lowered, and the position of ironmasters for competition be improved.

On 'Change, Swansea, the importation of American steel has formed of late a common topic, opinions varying considerably upon the point whether America is really able to put steel into the Bristol Channel ports at a profit, or whether a loss has not been suffered, and put up with for election or ulterior reasons. Good authorities are inclined to the opinion that the latter are visionary, and that the same practical foresight which enables America to be independent of this country, first in making its own iron rails, then steel rails, and latterly tin-plates, is again in evidence. Those who take this view say that the advantages enjoyed by the United States are due principally to Lake Superior ore, and the Pennsylvania fuel supply. It follows that, as a difference of £1 per ton is obtained in the cost of pig, the basis material used in the manufacture of steel, the rivalry is conducted up to the complete production of bar and billet, with an advantage to the American. It remains now to be seen whether, with reduced cost of raw materials, fuel, &c., and lowered wages, the prices of Welsh bar and billet cannot be so equalised that the superior merits of Welsh and conveniences of obtaining supplies will put the American behind in the competition. Interest is generally awakened with regard to the aspect of things as the New Year opens.

Swansea imported 666 tons of pig iron last week, 2500 tons of iron ore, and shipped the large total of 81,299 boxes tin-plates. The make of tin-plates was fairly large, 64,441 boxes. Present stocks are down to 121,490 boxes, as compared with 138,353 boxes the preceding week and 163,143 boxes at the corresponding date last year.

In anticipation of the quiet week to follow, most of the industries were in vigorous action last week, and it is reported that not a bar was in stock at the close for tin-plate purposes. At the Duffryn, in the Swansea Valley, two mills were at a standstill, three at the Beaufort, and two at Pontardawe. This week most of the Morristown will be idle up to Thursday. At Upper Forest the steel-producing industry is in a serious condition; two furnaces are idle.

The sulphate of copper industry at Llansamlet is very brisk. With moderating weather some large cargoes of tin-plates are going to New York, and two to Odessa and Batoum.

Promising reports are to hand of the spelter refineries. On Change, last week, it was stated that extensions are in good progress at White Rock, Middle Bank, Dilwyns, Villiers, Vivians, and Swansea Vale refineries.

On Saturday 3300 tons iron ore from Ergasteria came in for the Pyle and Blaina Company, together with 2452 tons manganese ore.

Port Talbot receipts for twenty-five weeks have totalled £29,373; Taff Vale last week £19,675, an increase of £2120 on corresponding week.

Work was generally resumed in the steel works on Wednesday night.

NOTES FROM GERMANY.

(From our own Correspondent.)

Activity in the iron and allied trades continues to be very limited. A further slackening off in demand was felt in many branches. Pig iron is in very moderate request, quotations not showing any change against previous weeks. Foundry pig has been in fair request for immediate consumption; other sorts of pig iron are more languid than formerly, and stocks increase. A very poor business only is done in billets, and there is next to no inquiry coming in for blooms; makers, therefore, find it difficult to maintain the price of M. 115 p.t. that is quoted for billets. Offers in scrap iron have been increasing during this week and the last, and prices are accordingly somewhat weak. The position of the manufactured iron trade leaves very much to be desired; activity at the rolling mills is insufficient, and the condition of some of the smaller works has been so unfavourable for some time past that it seems doubtful whether they will be able to continue operations much longer.

Bars in basic are quoted M. 125 to M. 130 p.t., and the latest price asked for Siemens-Martin bars was M. 140 p.t.; as billets are standing on M. 115 p.t. and the costs of rolling are about M. 30 p.t., it is needless to add that the mills are losing and not gaining by the orders they receive. A general want of employment is complained of in the hoop trade; the official quotation of M. 195 p.t. is only nominal, business is done at much lower rates, the mills being only too glad to secure an order, no matter how low the price agreed upon. One works in the Rheinland is reported to have offered hoops at M. 135 p.t. last week. All sorts of tubes are in exceedingly dull request, and the Silesian works have, by raising the rebate, reduced their quotations. There have been rather more inquiries received upon the week in the plate business; sheets, on the other hand, are weakly called for and quotations show an alarming tendency to move downwards, officially M. 150 p.t. is quoted, but offers have been made at M. 135 p.t. The wire mills find it difficult to maintain even a moderate activity, as next to no fresh work is given out; the syndicate has recently reduced the inland quotations for the first quarter of next year from M. 185 p.t. to M. 150 p.t. Very few orders are secured in wire nails; the business in hardware has been a trifle less languid than a few weeks ago, but prices all round are most unsatisfactory.

The wagon shops are in regular but not very brisk occupation just at present; prospects, however, may be considered favourable, as several orders of considerable weight will shortly be given out by the Railway Administration.

The production of pig iron in Germany, including Luxemburg, is statistically stated to have been, for November of present year, 710,018 t., of which 134,742 t. were forge pig and Spiegeleisen, 44,294 t. Bessemer, 399,446 t. basic, and 131,536 t. foundry pig. Output in October of present year was 742,720 t., in November last year 664,388 t. were produced. From January 1st to November 30th of present year 7,630,952 t. were produced, against 7,384,231 t. for the corresponding period the year before.

The North-Western group of the Union of German Iron and Steel Masters has requested the Minister of Public Work to grant a reduction in the tariffs for ore and also to reduce the freight to German, Dutch, or Belgian ports for all sorts of wire, as well as for wire nails, bars, drawn wire, rivets, axles. The decrease in export is considered the cause of this request.

Both engine and house coal remain in good demand on the German coal market, and coke is also briskly called for. The Prussian State Railway Administration is reported to have placed orders for next year's requirements in coal—3,000,000 tons—with the Rhenish-Westphalian Coal Convention at the old price of M. 11·10 p.t. All sorts of iron and steel remain in dull request in Austria-Hungary, only merchant iron forms an exception, a fair demand having been experienced during the week.

Here and there orders for delivery in the first quarter of next year have been placed, but the work given out is of small weight, owing to the general feeling of uncertainty which prevails in the iron and steel trades. Prices have not been officially reduced since former letters, but, of course, lower rates are willingly accepted wherever an order of some weight is offering.

Supplies in coal being plentiful on the Austro-Hungarian market, the tone generally has lost a good deal of its former stiffness and prices have been a little easier than formerly.

Belgian ironmasters may justly consider the present state of the iron business unsatisfactory in the extreme; next to no fresh work is given out, and as the few orders previously booked are not sufficient to keep the mills and shops even moderately occupied, output is restricted and the working staff reduced at most establishments.

The French iron market is, if possible, even more dull than the Belgian. The outlook all round is anything but hopeful, and many are expecting a further falling off in demand for the first months of the new year.

The most recent engines built at the Crewe works of the London and North-Western Company are ten eight-coupled mineral engines.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, December 13th.

UNTIL after the holidays there will be only a moderate demand for iron and steel material, according to present indications. Between November 10th and December 8th the larger consumers were heavy buyers of material, especially of plates and structural material. Some contracts extend far into next year. In other kinds less buying was done, and, in fact, fluctuations of prices have been not infrequent. Much uncertainty prevails as to prices. Consumers are unwilling to take much risk, knowing that there is an enormous productive capacity at work. Many buyers refuse to cover any further into 1901 than the work in hand demands. Those who control the ore situation will not fix prices until late in January, giving as a reason that consumers by that time may have decided to buy for summer delivery. The rush for shipyard and car factory work has not fallen off until within a week. Billets are held at 21 dols. at mill, and Bessemer at about 14 dols., an unusual difference. Bars are active, and the mills of the Republic Iron and Steel Company are busy. All the great combinations are exercising a strong hold on prices and production. The general belief is that the sales for 1901 will considerably exceed those of 1900. Iron and steel masters express themselves as well satisfied with the situation, and feel that better conditions await them. The latest steel combination was effected in this city last Friday, and emphasised the fact by an advance of 1 dol. per ton. Among the companies entering this combination are the Carnegie Steel Company, Federal Steel Company, National Steel Company, Jones and Laughlin's, Tidewater Steel Company, Worth Brothers, Lukens Iron Company, Central Iron and Steel Company, Pottstown Iron Company, and Glasgow Iron and Steel Company. The eastern millowners stand in dread of the competition of western mills, because of reduced freight rates. There is a report abroad that the Carnegie Company will build a large steel plant near Conneaut or Astabula, on Lake Erie, 150 miles north of Pittsburgh. Work at locomotive works is very good. The Norfolk and Western has ordered ten at the Richmond Works. All locomotive works are oversold for months to come. General business conditions are good. The labour of the country was never more fully employed. Jobbers and wholesalers report a large volume of business—a little less than last year; but there is no speculation in this year's business, and prices are lower. Congress is in session, and has before it schemes to expend several hundred millions of dollars, among which are the ship subsidy measure.

LAUNCHES AND TRIAL TRIPS.

SUTHERLAND, steel screw steamer; built by, William Doxford and Sons, Limited; to the order of, The Sutherland Steamship Company, Limited, Newcastle; dimensions, 340ft., 45½ft., 27½ft. moulded; to carry, 3546 tons gross register on 22ft. 2½in. draught; engines, triple-expansion, 26in., 42in., 68in., by 42in. stroke, pressure 160 lb.; constructed by, the builders; launch, December 20th.

FARMAND, steel cargo steamer; built by, The Laxevaags Engineering and Shipbuilding Company, Bergen; to the order of, O. and H. Irgens, of Bergen; dimensions, 256ft., 36ft., and 19ft.; engines, triple-expansion, 17½in., 29in., 48in., by 33in. stroke, pressure 175 lb.; constructed by, the builders; launch, December 20th.

ALMANACS, DIARIES, &c.

Calvert's Mechanics' Almanack for 1901 retains most of its old familiar features. This popular little annual is now in its twenty-eighth year of publication, but still has not departed from its original aim, namely, the provision of a companion to the artisan.

The Railway Diary and Officials' Directory for 1901, published by McCorquodale and Co., Limited, contains all the usual features of value to railway men. There is an excellent calendar, useful diary, and all the information likely to be required concerning the railways in Great Britain and Ireland.

The Gloucester Diary, which has now attained its sixth year of issue, is published for the Gloucester Railway Carriage and Wagon Company, Limited. In addition to some information regarding the City of Gloucester, the work is intended to form a handy memorandum book for directors of companies. It is neatly printed and bound.

CATALOGUES.

Consolidated Telpherage Company, Broad-street, New York. Illustrated leaflets of aërial cableways.

The British Westinghouse Electric Manufacturing Company, Limited, London. Circular No. 1036. Belt-driven single-phase alternators.

J. and E. Hall, Limited, Dartford, Kent. Illustrated catalogues of ice-making and refrigerating installations for land and marine purposes. —These pamphlets form a highly complete and readable treatise on the carbonic anhydride process for producing cold. The printing and general get-up of the books leave nothing to be desired.

TRADE AND BUSINESS ANNOUNCEMENTS.

WE are informed that Mr. Slater Lewis, of "Norwood," Ellesmere Park, Eccles, has retired from the position of engineer and general manager to P. R. Jackson and Co., of Manchester, and that he has accepted a seat on the board of the Brush Electrical Engineering Company, Limited.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

*** When inventions have been "communicated" the name and address of the communicating party are printed in italics.

11th December, 1900.

22,543. BOTTLES, A. E. Lyons, London.
22,544. BOTTLES, A. E. Lyons, London.
22,545. LUBRICATOR, J. Simpson and Co., Limited, and J. Burdon, London.
22,546. INTERRUPTORS for GAS ENGINES, T. Bergmann, London.
22,547. SPINNING MECHANISM for TOYS, R. D. Radcliffe, London.
22,548. INDICATING COURSE of BULLETS, R. Slazenger, London.
22,549. LIFTS, G. W. Jackson and E. O. Fearnley, Manchester.
22,550. COIN-OPERATED GAME, H. W. Toms, London.
22,551. PUMP for COMPRESSING GASES, S. Puplett, London.
22,552. EXPANSION STEAM TRAPS, F. Foster, London.
22,553. DRIVING MECHANISM for CYCLES, A. Jarvis, London.
22,554. TREATMENT of COMPLEX ORES, E. H. Hopkins, London.
22,555. MEASURING STANDARD for HORSES, E. R. Arnold, London.
22,556. OBTAINING OXIDE from ORE, J. B. de Aizugaray, London.
22,557. EXTRACTING GOLD from ORE, J. B. de Aizugaray, London.
22,558. SOLE-ROUNDING MACHINE, H. H. Lake.—(*G. H. P. Flagg, United States.*)
22,559. WATER-CIRCULATING DEVICE, F. H. Fitzler, London.
22,560. BRAKE MECHANISM, H. E. Gresham, Manchester.
22,561. CIGAR-MAKING MACHINES, J. R. Williams, London.
22,562. MECHANICAL EDUCATIONAL DEVICE, W. Redfern, London.
22,563. ROTARY MOTOR, W. H. Bushell and L. R. S. Tomalin, London.
22,564. ROTARY PUMP for AIR and WATER, J. Aitken, London.
22,565. BRAKE MECHANISM, S. Straker and E. Clare, London.
22,566. TELESCOPE for ORDNANCE, A. A. Common, London.
22,567. MACHINE for BENDING RAILS, V. Demerbe, London.
22,568. BREECH-LOADING SPORTING GUNS, R. Darne, London.
22,569. BUILDING SLABS, A. J. Boult.—(*E. G. Fuchs, Germany.*)
22,570. RECOVERING ZINC from ORE, H. F. Kirkpatrick-Picard, London.
22,571. CYCLE CRANKS, J. Speaight, London.
22,572. ELECTROSTATIC MACHINE, K. Schall.—(*Reiniger, Gebbert, and Schall, Germany.*)
22,573. SPEED-CHANGING GEAR for CYCLES, F. A. Rich, London.
22,574. VARIABLE-SPEED GEAR, A. Sharp, London.
22,575. SIGNALLING, C. M. Jacobs, R. J. Insell, and E. F. Newton, London.
22,576. SYPHON for AERATED BEVERAGES, M. Adelstein, London.
22,577. SAFETY LAMP, R. B. Anderson and A. S. Hamilton, London.
22,578. WATER-PRESSURE INDICATOR, H. H. Lake.—(*Luzsche Industriwerke A.-G., Germany.*)
22,579. STEAM HEATING PIPES, J. P. Schroeter, London.
22,580. CLASPS, W. W. Lean, London.
22,581. LIQUID-FILTERING APPARATUS, H. Desrumaux, London.
22,582. RECEPTACLES for DISCRETE MATERIALS, S. R. Bellingham, D. Fell, and N. P. Richards, London.
22,583. MOTOR ROAD VEHICLES, E. G. Hoffmann, London.
22,584. ELECTRIC FURNACE with TWO BED-PLATES, C. A. Keller, London.
22,585. SUPPORTING ELECTRIC LAMPS, W. F. Brewster, London.
22,586. PROCESS of FORMING ICE, W. P. Thompson.—(*The International Ice Company, United States.*)
22,587. GAS LIGHTERS, W. P. Thompson.—(*Wolff and Co., Germany.*)
22,588. FIRE-ESCAPE, W. Jones.—(*R. Owen, on the High Seas.*)
22,589. COLLAPSIBLE VESSELS, J. Hoffstadt, Liverpool.
22,590. TREATMENT of SEAWEED, &c., T. Ingham, Liverpool.
22,591. MAGNETIC ORE SEPARATORS, C. A. Barnard, Liverpool.
22,592. DEALCOHOLISING FERMENTED BEVERAGES, A. Müller, Liverpool.
22,593. BOSH PLATES, A. R. Reese and E. Smeeth, London.
22,594. REVERSING GEAR, W. F. Faenecke, London.
22,595. AIR-CARBURETTING APPARATUS, J. Fillet, London.
22,596. PROCESS for COLOURING GLASS, N. Meurer, London.
22,597. STEAM ENGINES, R. Kron, London.
22,598. GAS METERS, W. L. Wise.—(*The Actien-Gesellschaft für Automatische Zünd und Lösch-apparate, Switzerland.*)
22,599. ELECTRIC GLOW LAMPS, A. Just and R. Falk, London.
22,600. REVERSING VALVES, D. J. Hosington and J. W. Keasinger, London.
22,601. LIGHTING FLUIDS, W. L. Wise.—(*The Aktien-Gesellschaft für automatische Zünd und Lösch-apparate, Switzerland.*)
22,602. VEGETABLE FAT, G. C. Watt and W. T. Wright, London.
22,603. MACHINE for CUTTING BLOCKS, W. N. Shott, London.
22,604. STEAM PUMP or MOTOR, A. N. Sancowsky, London.
22,605. ELECTRIC ACCUMULATORS, T. Müller, London.
22,606. MATERIAL for ELECTRIC ACCUMULATORS, T. Müller, London.
22,607. ELECTRIC ACCUMULATOR CELLS, T. Müller, London.
22,608. ROTARY ENGINES, L. C. Krummel, London.
22,609. BUCKLES, J. E. Hogarth, London.
22,610. SELF-LIGHTING CIGARETTES, P. Guadagnini, London.
22,611. GAUTAMA SPARK ARRESTER, W. M. Noott, London.

12th December, 1900.

22,612. OIL CARRIAGE LANTERN, H. E. Phillipson, Dublin.
22,613. KEYS, J. E. Simpson, Liverpool.
22,614. SAFETY APPARATUS for LIFTS, A. Guest, London.
22,615. TRAMWAY POINT CHANGER, H. R. Brown, Dublin.
22,616. SIGHTING DEVICES for FIRE-ARMS, T. G. Russell, Lewes.
22,617. STEAM GENERATOR, J. E. H. Bannister, Southsea.
22,618. INCANDESCENT GAS LIGHTING, W. Harris, Chorley.
22,619. MIRROR-SUPPORTING DEVICE, F. Kühn, Liverpool.
22,620. SECURING DOORS in DIFFERENT POSITIONS, R. Watt, Glasgow.
22,621. SECURING "LEE-BOARDS" of SHIPS' BERTHS, D. McLaren, Glasgow.
22,622. DESPATCH and MONEY BELT, C. Irwin, Guernsey.
22,623. ELECTRO-PNEUMATIC ORGANS, R. Hope-Jones, Norwich.
22,624. PLUG for BOTTOM of LASTS, J. E. Hodgson, Kettering.
22,625. DRESSING-BOX for BATHS, F. R. R. J. Pearce, London.
22,626. WOOD-BLOCK FLOORING, T. Golding and H. Ansell, Southampton.
22,627. STOCKS of PLATE LOCKS, C. R. Heckford, Wolverhampton.
22,628. CUTTING BUTTER out of FIRKINS, A., J., and G. Lyons, Manchester.
22,629. OILING WOOL in CARDING ENGINES, H. Thornton, Manchester.
22,630. CHAIRS for BABIES, H. D. Fitzpatrick, Glasgow.
22,631. PREVENTING SMOKE in FURNACES, J. H. Kenyon, Manchester.
22,632. LIFE GUARD for TRAMCARS, M. Cohen, Manchester.
22,633. PHOTOGRAPHIC PRINTING FRAMES, J. and A. Wilkinson, Manchester.
22,634. LOOMS for WEAVING, H. Haworth, H. Carus, and J. Livesey, Halifax.
22,635. COLLAPSIBLE LETTER BOXES, A. E. Walker, London.
22,636. PUMPS for RAISING BEER, J. T. Thorton, Huddersfield.
22,637. RIM BRAKES for CYCLES, G. Luckman, Birmingham.
22,638. RULING PEN ADAPTOR, P. M. Perry, Sheffield.
22,639. MALLETS for PLAYING CROQUET, C. A. Stevenson, Edinburgh.
22,640 NEWSPAPER PRINTING MACHINES, T. L. Whitehead, Manchester.
22,641. VARYING PRESSURE in LIQUIDS, E. B. Smith and E. Asquith, Manchester.
22,642. CUTLERY-POLISHING MACHINES, C. F. and C. H. J. Dilg, New York.
22,643. GAS BURNERS for FURNACES, C. Humfrey, Liverpool.
22,644. WASHES for PRODUCER GASES, C. Humfrey, Liverpool.
22,645. GRATES HEATED by GAS, C. Humfrey, Liverpool.
22,646 BINDING CASES for FILED PAPERS, E. G. Dow, London.
22,647. MACKINTOSH with WATERPROOF LINING, E. T. Johnston, London.
22,648. AN ALARM DEVICE, W. Welford, London.
22,649. STRETCHING TROUSERS, C. A. M. Anderson, Swindon, Wilts.
22,650. INSERTING STUDS into SHIRTS, C. A. M. Anderson, Swindon, Wilts.
22,651. FUSES and EXPLODERS, A. W. Marshall, London.
22,652. CONNECTION for PIPES and TAPS, A. T. Wedelin, London.
22,653. BRAKE MECHANISM for CYCLES, A. Rattray, London.
22,654. RECEPTACLE for CATTLE CAKES, H. K. Stone, London.
22,655. MOTOR CARS, H. A. Taylor, Birmingham.
22,656. DRESS SUSPENDER, A. Knowles, Birmingham.
22,657. COMBING WOOL, J. Hayes, J. E. Tatham, and W. H. Vernon, London.
22,658. STOPPING RUNAWAY HORSES, A. Reichel, London.
22,659. ANCHORS, L. W. Bates, London.
22,660. PREVENTING REFILLING of BOTTLES, M. F. Jones and E. C. Halson, Ilford, Essex.
22,661. FIRE-ESCAPES, J. C. Hudson, London.
22,662. GLOW LAMPS, F. Blau, A. Scharf, I. and S. Löti, and R. Latzko, London.
22,663. TENTS, A. Milne, London.
22,664. ATTACHING TIRES to WHEELS, J. Roberts, Liverpool.
22,665. ELECTRIC LOCOMOTIVE TROLLEYS, E. J. Faraday, Liverpool.
22,666. AUTOMATICALLY OPERATING VENTILATORS, H. Simpson and R. Thomlinson, Liverpool.
22,667. "RECUTTING" FILES, L. M. Lafontaine, London.
22,668. KETTLES, J. H. Wickham, London.
22,669. TONGS for PHOTOGRAPHIC DEVELOPING PURPOSES, J. T. Partridge, London.
22,670. TOBACCO PIPES, W. Rowthorn, London.
22,671. WINDOW SASHES, I. Fripp and N. Way, London.
22,672. ADJUSTABLE GALLERY for LAMP GLOBES, T. E. Brown, London.
22,673. LUMINOUS ADVERTISING, J. T. F. Conti, London.
22,674. IMPRESSING STEREOTYPE MATRICES with MUSICAL NOTES, A. Réveillé, London.
22,675. MATHEMATICAL COMPASSES, E. T. Boden, Liverpool.
22,676. MACHINES for HACKLING FLAX, J. V. Eves, Manchester.
22,677. TURBINES, J. W. Graydon and L. H. Greig, London.
22,678. TRANSMITTING ENERGY, S. H. Short, London.
22,679. OPERATING ELECTRICALLY-PROPELLED TRAINS, S. H. Short, London.
22,680. SWITCHING APPARATUS, R. P. Wilson, London.
22,681. SLIDING WINDOWS, C. A. Bond and F. R. Strickland, London.
22,682. MOTOR CARS, H. H. L. Lewis, London.
22,683. RAILWAY AUTOMATIC COUPLINGS, A. Stevens and C. Spratt, London.
22,684. GIVING the CRUNCHING of SILK to MERCERISED COTTON, H. E. Newton.—(*The Farbenfabriken vormals F. Bayer and Co., Germany.*)
22,685. COIL CLUTCHES or BRAKES, H. E. Brown, London.
22,686. RAILWAY WAGON BUFFERS, T. A. Brockelbank, London.
22,687. CYCLE STANDS, A. Pait, London.
22,688. PHONOGRAPH, J. Bradford and T. D. Addis, London.
22,689. BANDOLIER, N. W. Wallace, London.
22,690. ELECTRICAL TRACTION, K. J. and J. A. McMullen, London.
22,691. CARBURETTORS for EXPLOSION ENGINES, C. Osborn and The British Motor Traction Company, Limited, London.
22,692. ELECTRIC IGNITION DEVICES, C. Osborn and The British Motor Traction Company, Limited, London.
22,693. GAS ENGINES, W. and K. A. Rowbotham, Birmingham.
22,694. INCANDESCENT GAS LIGHTING, J. B. de Lery, London.
22,695. DRINKING VESSELS, &c., L. Pulmowski, London.
22,696. PHOTOGRAPHIC FIXING MACHINE, H. Löscher, London.
22,697. PHOTOGRAPHIC COPYING MACHINE, H. Löscher, London.
22,698. REDUCING METALS by ELECTROLYSIS, H. A. Frasch, London.
22,699. SEPARATING METALS from ORES, H. A. Frasch, London.
22,700. PRINTING, &c., BLANK TICKETS, G. Langé, London.
22,701. RAILWAY TICKET-PRINTING MACHINE, G. Langé, London.
22,702. SLIDING CANVAS TARGET, R. C. Murray, Manchester.

13th December, 1900.

22,703. ELECTROLYTIC REFINING of COPPER, S. Cowper-Coles, London.
22,704. INDUCTION COILS, W. E. Ayrton and W. Duddell, London.
22,705. BOLTING WIRE for PIGEON TRAPS, E. H. Trow, West Bromwich.
22,706. CIRCULAR KNITTING MACHINES, T. Morley, Leicester.
22,707. IMPROVED MACHINES for KNITTING, J. Haddow, Glasgow.
22,708. SKEWERS for BUTCHERS, J. Orton, Wolverhampton.
22,709. TEXILE DRAWING FRAMES, J. Moorhouse, Manchester.
22,710. COUPLING for AIR PUMPS, F. Hulme, Manchester.
22,711. PNEUMATIC TIRES for VEHICLES, S. H. Stubbs, Manchester.
22,712. PROTECTING GALVANOMETERS, A. Whalley, Helsby, near Warrington.
22,713. ELECTRIC SWITCHES, A. Whalley, Helsby, near Warrington.
22,714. SHIPS' OIL LAMPS, E. H. Griffiths, Birmingham.
22,715. HOLDFAST BRUSHES, J. B. Meesom and T. J Pickford, Leeds.
22,716. SELF-DRIVING MOTOR, R. Crawford, Dublin.
22,717. BALL VALVES, C. R. Winn and A. Mousley, Birmingham.
22,718. COIN-FREED AUTOMATIC MACHINES, T. Harrison, Newcastle-on-Tyne.
22,719. WINDOW BLIND, J. D. Hodgson and J. D. Richardson, Newcastle-on-Tyne.
22,720. LIGHTING APPARATUS for GAS PURPOSES, J. W. Blakey, Bradford.
22,721. ANTI-VIBRATOR for INCANDESCENT GAS LIGHTING, J. W. Blakey, Bradford.
22,722. HEDDLE OPERATING MECHANISM for LOOMS, C. Nixon, Keighley.
22,723. CONVERTING CANE SUGARS into INVERT SUGAR, R. D. Bailey, London.
22,724. INCANDESCENT GAS LAMP CHIMNEYS, R. Warwick, Leyton.
22,725. SPINNING FRAMES, R. W. Moncrieff, Newport Pagnell, Bucks.
22,726. CHECKING TRAM TICKETS, W. Foxton, Scarborough.
22,727. FISH PASS, P. D. Malloch, Glasgow.
22,728. STOCKLESS ANCHORS, R. Baird, Govan.
22,729. MAKING DIGESTIVE BREAD, R. Graham, Springfield, Fife.
22,730 GLAZING BARS for ROOF LIGHTS, W. R. Lester, Glasgow.
22,731. INCREASING the EFFICIENCY of ELECTRICAL MACHINES, F. Tudsbury, Newark.
22,732. SMOKE-CONSUMING FIREPLACE, H. Hodgson, Shipley.
22,733. HAND-BARROWS, G. W. Sutton, Great Baddow, near Chelmsford.
22,734. COMBINED RIM BRAKE and FOOT-REST, E. Perkins, Gainsborough.
22,735. PATENT BASINS, E. H. Trow, West Bromwich.
22,736. APPARATUS for HEATING, J. Johnston, Manchester.
22,737. WOOD-WORKING TOOLS, J. Pring and C. R. Fitt, London.
22,738. GAS SCRUBBERS, S. S. and S. B. Chandler, London.
22,739. VALVES for PNEUMATIC TIRES, P. Rupp, London.
22,740. GAITER FASTENINGS, E. D. E. Jukes.—(*C. C. W. Biddis, Natal.*)
22,741. PRESERVING ROASTED COFFEE, S. Feitler, London.
22,742. BRICK MACHINES, D. A. Koizer, Winnipeg, Manitoba.
22,743. PACKING MATCHES, H. Sevène and E. D. Cahen, London.
22,744. GEAR for CHANGING SPEED, P. G. Tacchi, London.
22,745. FRICTION CLUTCH, E. F. Stone and H. S. Coolidge, London.
22,746. CUTTING TOOTHED GEAR WHEELS, H. Bilgram, London.
22,747. ELECTRO-MAGNETIC BRAKES, F. L. Clark, London.
22,748. ELECTRO-MAGNETIC BRAKES, F. L. Clark, London.
22,749. PROJECTILES, J. H. S. Bradley, London.
22,750. TOY GUN, A. D. Vidler, London.
22,751. BEDSTEADS for INVALIDES, &c., C. Spurrell, London.
22,752. PIPES for SMOKING TOBACCO, &c., C. Toft, London.
22,753. HOLDING BLOCKS, J. H. Simpson and E. W. H. Walker, London.
22,754. MACHINE for MOULDING DOUGH, F. J. Griffin, London.
22,755. METALLIC BOXES, E. Besse and L. Lubin, London.
22,756. GAS EXPLOSION MOTORS, G. P. Pradel, London.
22,757. MAKING CHAIN CABLES, R. Priest, Birmingham.
22,758. MANUFACTURE of ACIDS, O. Imray.—(*Farbwerke vormals Meister, Lucius, and Bruning, Germany.*)
22,759. ENDS of FISHING RODS, A. Wilkes, Birmingham.
22,760. LOCOMOTIVES, I. A. Timmis.—(*G. W. Reid, Natal.*)
22,761. MANUFACTURE of FOODS, I. A. Timmis, London.
22,762. MECHANISM for OPERATING VALVES, C. Osborn and The British Motor Traction Company, Ltd., London.
22,763. FRICTION DRIVING MECHANISM, C. Osborn and The British Motor Traction Company, Ltd., London.
22,764. TYPEWRITER, A. C. Ferguson and C. E. Smith, London.
22,765. LOCKS, M. L. Shively, London.
22,766. MAKING ARTIFICIAL STONE, J. P. Burn London.
22,767. SACCHARINE SOLUTIONS, W. P. Thompson.—(*J. H. Lavollay and G. E. Bourgoin, France.*)
22,768. ATTACHMENT for SEWING MACHINE, J. C. Moore, London.
22,769. CHAIRS for USE of CHILDREN, E. Baumann, London.
22,770. CLEANING METAL, W. P. Thompson.—(*S. Bein, Germany.*)
22,771. APPARATUS for CASTING BATHS, W. W. Chapman, Liverpool.
22,772. DETACHABLE LIDS for TANKS, R. Pritchford, Birmingham.
22,773. SPOOL CARRIERS for LOOMS, G. Williams, Birmingham.
22,774. FEED-WATER HEATERS for BOILERS, T. Davis, London.
22,775. ELECTRIC GENERATORS, Callender's Cable and Construction Company, Ltd., and J. O. Callender, London.
22,776. DYEING TEXTILE MATERIAL, G. de Keukelaere, London.
22,777. SMELTING FURNACE, O. Forsbach and E. Clerc, London.
22,778. UMBRELLA STICKS, R. Haddan.—(*G. Rau, Germany.*)
22,779. TELEPHONIC INSTRUMENTS, M. Byng and F. G. Bell, London.
22,780. MAKING BARS, D. J. Jarvis, J. W. Wadkin, and T. S. King, London.
22,781. EXTRACTING GOLD from ORES, W. T. Forbes, London.
22,782. ACETYLENE GAS, W. W. Clark and G. Bone, London.
22,783. CORSET BUSKS, F. C. Nutter, London.
22,784. COOLING CYLINDERS of EXPLOSION ENGINES, E. C. Blackstone and F. and E. Carter, London.
22,785. MANUFACTURING FERRO SILICIUM, M. L. E. Duval, London.

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22,786. INCANDESCENT GAS LIGHTING, J. Wilson, Birmingham.
22,787. STOPPING SPINDLES OVERRUNNING, J. Mason and F. Rhodes, Leeds.
22,788. PIPE JOINTS, H. L. Doulton and C. E. Morris, London.
22,789. ELECTROLYTIC TUBE MAKING, S. Cowper-Coles, London.
22,790. PACKING PISTONS, W. and K. A. Rowbotham, Birmingham.
22,791. BEDSTEADS, J. A. Crane, Birmingham.
22,792. HEMS for DRESSES, F. Waldeck, Barmen, Germany.
22,793. HEATING AIR, A. Robinson and K. C. McDowell, Belfast.

22,794. Point for Use on Railways, A. E. Watson, Sunderland.
22,795. Holders for Walking Sticks, E. J. Alford, Bury.
22,796. Chain-driving Gear for Cycles, A. Sharp, London.
22,797. Boring Bar, J. Weller, West Norwood, Surrey.
22,798. Automatic Switches, A. H. Mayes, Hove, Sussex.
22,799. Golf Ball, J. Duncan, Glasgow.
22,800. Street Tramway Points, H. Tee, Liverpool.
22,801. Electric Lamps, W. McG. Douglas, Liverpool.
22,802. Boots, J. R. Miller, Glasgow.
22,803. Suspending Device for Cycles, R. J. Smith, Newcastle-upon-Tyne.
22,804. A Stretching Frame for Paper, T. Cox, Birmingham.
22,805. Brake for Hand Trucks, A. G. Strong, Bristol.
22,806. Manufacture of Parts of Kettles, A. Hateley, Birmingham.
22,807. Loom Shuttles, J. Jucker.—(*U. Rüsch, Switzerland.*)
22,808. Cornice Poles, S. Russell, Birmingham.
22,809. School Desks, C. W. Robbins and S. F. Poynor, Leicester.
22,810. Valves, G. M. and W. Marchant, Ashton-under-Lyne.
22,811. Tubular Pan for Boiling Sugar, C. Cade, Stamford.
22,812. Self-contained Spindles, E. Sykes, Huddersfield.
22,813. Fire Screens, A. A. Haigh and F. W. Sephton, Manchester.
22,814. Safety Riding Stirrup, H. Hall, Rainhill, Lancs.
22,815. Coupling Apparatus, W. P. and J. Riley, Southampton.
22,816. Photograph Frames, &c., G. Hemming, Birmingham.
22,817. Actuating Air Compressors, E. Gittings, jun., Birmingham.
22,818. Clutch Mechanism, G. V. Fowler, Birmingham.
22,819. Electric Fuses, A. Eckstein and A. J. D. Krause, Manchester.
22,820. Machine for Brushing Roads, S. C. Emery, Birmingham.
22,821. Circular Fan for Ventilation, H. Sidebottom, Manchester.
22,822. Cuff Fixing, T. W. Vipond, Newcastle-on-Tyne.
22,823. Girders, H. R. Vaughan and The Patent Vulcanite Roofing and Asphalte Company, Limited, Glasgow.
22,824. Distributing Electric Current, E. Arnold, O. S. Bragstad, and J. L. la Cour, London.
22,825. Changing Shuttles of Looms, E. Immer, Baden.
22,826. Open-hearth Steel, J. L. Stevenson, Middlesbrough.
22,827. Blast Furnaces, J. L. Stevenson, Middlesbrough.
22,828. Open-hearth Furnaces, J. L. Stevenson, Middlesbrough.
22,829. Non-refillable Bottles, J. Liddle.—(*W. Grayson, United States.*)
22,830. Steam-superheating Apparatus, H. Cruse, Manchester.
22,831. Coin-prepayment Mechanism, R. Kennedy, Glasgow.
22,832. Portable Domestic Fireplace, E. C. L. Close, London.
22,833. Spring Cylinder for Bicycles, J. Kennedy, Belfast.
22,834. Automatic Coupling for Trucks, G. Paddon, Cork.
22,835. Automatic Railway Signals, R. W. Spence, London.
22,836. Water-distilling Apparatus, H. A. Vachell, London.
22,837. Railway Signalling, A. W. Richardson and A. A. Stoddard, London.
22,838. Folding Trestles, J. T. Jenkins, London.
22,839. Outdoor Seats, J. Wilson and G. O. Ibbetson, London.
22,840. Butter, A. J. Boult.—(*C. M. Taylor, jun., United States.*)
22,841. Knife-filing Machines, A. Berridge, London.
22,842. Nails and Rivets for Boots, H. Laymann, London.
22,843. Apparatus for Unloading Coal, W. H. Duncan, London.
22,844. Furnaces, E. J. Clubbe and A. W. Southerp, London.
22,845. Seat Pillars for Cycles, &c., A. J. Ködel, London.
22,846. Railways, D. Cook, London.
22,847. Invoice Form, G. J. V. Gold, London.
22,848. Arc Lamps, J. D. F. Andrews, London.
22,849. Exhibiting Photographs, A. M. W. Lehfeldt, London.
22,850. Cocks, V. Laserme, London.
22,851. Automatic Electric Post, E. L. Gordon, London.
22,852. Syphonic Flushing Apparatus, C. F. Dixon, London.
22,853. Heating Systems, D. W. Anderson, E. B. Thaw, J. F. Chalmers, and J. T. Wright, London.
22,854. Sole Edge Trimmers, P. Jensen.—(*E. E. Angell, United States.*)
22,855. Sole Edge Trimmers, P. Jenson.—(*E. E. Angell, United States.*)
22,856. Purifying Air, A. Desgrez and V. Balthazard, London.
22,857. Lamps for Burning Petroleum, S. Biheller, London.
22,858. Coal Screen for Retorts, F. W. Cross, Leyton, Essex.
22,859. Dolly Washer, H. Smith, Peterborough.
22,860. Incandescent Lamps, C. A. von Welsbach, London.
22,861. Laundry Mat, J. Gridley, Kingston-on-Thames.
22,862. Boat-engaging Gear, F. S. Pett, London.
22,863. Camp Stools, C. E. Burnap and J. K. Sheffy, London.
22,864. Elastic Tires, W. A. Barrows and N. Sanford, London.
22,865. Ascertaining Amount of Hæmoglobin in Blood, S. L. Fox, London.
22,866. Extracting Pens from Holders, A. J. Davis, London.
22,867. Lubricant, M. S. Hudnall and H. Calvert, London.
22,868. Free-wheel Driving Gear, W. J. S. Grawitz, London.
22,869. Reducing Vibration in Cycles, G. W. Walker, London.
22,870. Cameras, G. W. Walker, London.
22,871. Means for Playing Violins, W. H. Pusey, London.
22,872. Electric Incandescent Lamps, E. Bushe, London.
22,873. Cartridges for Fire-arms, R. W. Scott, London.
22,874. Cycles, N. A. Sawyer, London.
22,875. Chain Stays for Bicycles, L. Smallwood, Birmingham.
22,876. Life-saving Apparatus, H. H. Lake.—(*M. Delmard and — Eldington, Grand Canary.*)
22,877. Collapsible Boats, V. Engelhardt, London.
22,878. Duplicating Typewritten Matter, H. H. Lake.—(*Société Industrielle, France.*)
22,879. Draw-off Valves, S. Wilkerson, London.
22,880. Cutting Roots, W. R. Draper and W. Parkin, London.
22,881. Cones for Holding Hats, C. Malchow and R. Otto, London.
22,882. Sewing Machines, M. T. Denne, A., A., and P. Cave, London.
22,883. Separating Impurities from Water, C. P. Taylor, London.
22,884. Advertising Apparatus, J. H. Reeves, London.
22,885. Advertising Apparatus, J. H. Reeves, London.
22,886. Wheels and Pulleys, J. M. Dodge, London.
22,887. Oxidation of Hydrocarbons, B. Willcox.—(*The Badische Anilin and Soda Fabrik, Germany.*)
22,888. Mixing Gases with Liquids, C. J. Baker, London.
22,889. Fly-catching Apparatus, C. Wenigmann, London.
22,890. Button-making Machines, W. P. Thompson.—(*W. A. Pendry, United, States.*)
22,891. Producing Drawings, G. Buchberger, Liverpool.
22,892. Protecting the Nuts of Boilers, L. Knowles, Manchester.
22,893. Car Doors, T. M. Dixon and T. Dawber, Manchester.
22,894. Working Gas Engines, H. Lane, Birmingham.
22,895. Producing Relief Pictures, A. Lembacher, London.
22,896. Carding Machines, C. F. and A. Renard, London.
22,897. Valve, C. Wehner, C. Maltner, and F. Bansen, London.
22,898. Appliance for Teaching Reading, R. Hints, London.
22,899. Manual Training Apparatus, J. E. Kelly, London.
22,900. Syringes for Surgical Purposes, M. Schmidt, London.
22,901. Cork Pullers, J. J. Schermack, London.
22,902. Electrolytic Apparatus, E. Edser and M. Wilderman, London.
22,903. Prepayment Gas Meters, W. Cowan, London.
22,904. Photographic Cameras, H. Siewers, London.
22,905. Manufacture of Margarine, A. Pellerin, London.
22,906. Valves, T. W. Worsdell, A. von Borries, and R. H Lapage, London.
22,907. Lighting Carriages, F. J. Beaumont and W. M. Still, London.
22,908. Lighting Carriages, F. J. Beaumont and W. M. Still, London.

15th December, 1900.

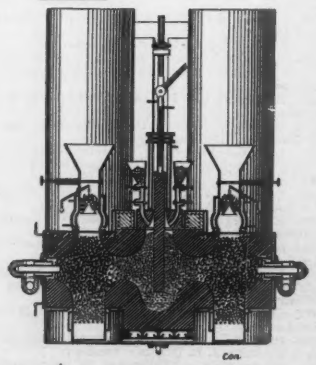
22,909. Machines for Sawing Wood, G. Pickles, Halifax.
22,910. Electric Lighting Pendents, J. B. Belcher, Stafford.
22,911. Thill Couplings, F. E. Fay, Kingston-on Thames.
22,912. Vehicles, F. Black, J. G. Lamb, and J. P. Clement, Kingston-on-Thames.
22,913. Wringing Mops, L. W. Richardson, Kingston-on-Thames.
22,914. Sun Blinds, T. W. and F. C. Tidmarsh, London.
22,915. Boxes for Holding Matches, A. J. Priestley, London.
22,916. Printing on Floor-cloths, D. P. Gourlay, Glasgow.
22,917. Spring Frames for Vehicles, E. A. Crowsley, London.
22,918. Manufacture of Sliver Cans, J. Kirkman, Manchester.
22,919. Transmission of Power for Brakes, W. R. Crabbe, Bristol.
22,920. Blocking Saddles of Bicycles, P. A. Martin, Birmingham.
22,921. Fastenings for Casements, A. Illidge, Wolverhampton.
22,922. Holders for Detonators, G. Edwards, Manchester.
22,923. Opening Cans, R. G. Smith and M. Hibbero, Birmingham.
22,924. Feeding Sheets to Printing Machines, E. T. Cleathero, London.
22,925. Double Spring Clip for Cycles, C. G. Cooper, Bristol.
22,926. Electric Shade Remover, A. Morrison, Manchester.
22,927. Lead Rivets, C. Darrah, jun., and J. G. Patterson, Manchester.
22,928. Bucket, W., F., and R Walker, and J. T. Freestone Liverpool.
22,929. Picker Savers in Weaving Looms, J. Booth, Manchester.
22,930. Shelf Support, J. J. Vernon and T. Whitaker, Stockport.
22,931. Manure-distributing Apparatus, R. Ross, Glasgow.
22,932. Letter Receiver, H. Eke. London.
22,933. Electric Coils, A. Eckstein and A. E. Angold, Manchester.
22,934. Manufacturing Hinges, S. Timings, Birmingham.
22,935. Copper Expansion Boxes, T. E. Mitton, Birmingham.
22,936. Pneumatic Ball Cycle Tire, W. Shone, Chester.
22,937. Bed Lift and Bed Rest, H. G. Monkhouse, London.
22,938. Securing Bolts in Position, F. F. Evans, London.
22,939. Curtain Clips, M. Schreiber and F. Radeck, London.
22,940. Binding Numbers of Magazines, J. J. Linzell, London.
22,941. Producing Artificial Stone, J. Doyle, Dublin.
22,942. Raising Water, J. Pavlovits and L. Nawy, Glasgow.
22,943. Treating Gas, W. J. Crossley and J. Atkinson, Manchester.
22,944. Furnaces of Steam Boilers, F. Priestley, Manchester.
22,945. Stopper for Bottle, E. and E. Defty, Blackpool.
22,946. Striking Plates for Locks, W. K. Kaye, Bradford.
22,947. Making Cloth from Yarn, R. Spitz, Bradford.
22,948. Belt Fastener, W. H. Nield and W. Melland, Manchester.
22,949. Audible Signalling on Railways, T. Lambert, Plymouth.
22,950. Printing on Goods, J. Harris, son., and J. Harris, jun., Manchester.
22,951. Interest Computing Machine, L. M. Landing, London.
22,952. Building Materials, G. Cuel and E. Bichler, London.
22,953. Treating Refractory Ores, W. W. Fyfe, London.
22,954. Treatment of Cotton Seeds, J. C. W. Stanley, London.
22,955. Consuming Smoke in Furnaces, H. Untiedt, London.
22,956. Coherers, L. B. Miller, London.
22,957. Separating Salt from Solution, W. P. Thompson, Liverpool.
22,958. Electric Railways, P. McCullough, T. Blaney, and R. Baron, Liverpool.
22,959. Wire-drawing Device, W. J. Glover, Liverpool.
22,960. Gas Generators, J. Shackleton and A. Ross, Liverpool.
22,961. Storing Eggs, F. Briggs and J. P. Tomlin, Liverpool.
22,962. Lenses, C. A H. Harting, Liverpool.
22,963. Engines, W. Schmidt, Liverpool.
22,964. Pumps, J. A. Morris and W. H. Bunch, Manchester.
22,965. Lubricators, J. A. Morris and W. H. Bunch, Manchester.
22,966. Making Sand Pins, F. C. Parish, Birmingham.
22,967. Keyholder, H. Schröder, Charlottenburg, Berlin.
22,968. Ore Concentrators, W. McDermott and F. E. Elmore, London.
22,969. Locks. S. R. Parkes, Birmingham.
22,970. Dry Seats for Tramcars, &c., W. Wrigley, London.
22,971. Changing Photographic Films, P. J. Job and T. Naylor, London.
22,972. Electric Lighting of Railways, E. M. Preston, London.
22,973. Bushes for the Hubs of Wheels, C. and H. Decelle, London.
22,974. Soldering Artificial Teeth, C. Fritsche, London.
22,975. Cone Clutches, C. D. Abel, London.—(*La Société Anonyme des Anciens Etablissements Panhard et Levassor, France.*)
22,976. Locking Nuts and Bolts, Bouchacourt et Cie., London.
22,977. Lathes, E. G. Paine, London.
22,978. Rope Couplings, W. Barkowsky, London.
22,979. Driving Mechanism for Lathes, J. Tangye, London.
22,980. Davits, A. W. Montgomery-Moore and J. Preston, London.
22,981. Magic Lanterns, G. W. Brown and G. R. Beaumont, London.
22,982. Globes for Electric Incandescent Lamps, G. Chisholm, Birmingham.
22,983. Pole Head for Carriages, T. H. Brigg and C. W. Walker, London.
22,984. Fritting Glass Composition, J. Noad, London.
22,985. Protecting Boots, M. S. and G. B. Whitford, London.
22,986. Dental Appliances, J. W. Cowan, London.
22,987. Wireless Electric Signalling Apparatus, C. G. Fernie, London.
22,988. Pyrotechnic Balloons, A. Brock, London.
22,989. Colouring Matters, B. Willcox.—(*Badische Anilin and Soda Fabrik, Germany.*)
22,990. Binding Walking Sticks, P. and O. Becker, London.
22,991. Fastener for Securing Veils, F. Morton, London.
22,992. Pipe Cleaners, T. B. Jebb, London.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

658,315. Electric Furnace, *A. H. Cowles, Cleveland, O.I.O.—Filed October 22nd*, 1895.

658,315.

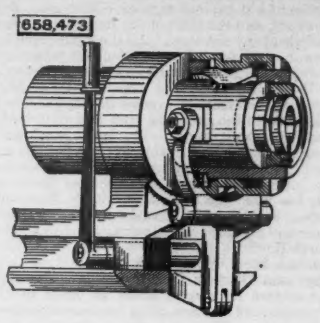


Claim.—(1) The combination in a furnace, of an electric smelting chamber to be charged with the material to be reduced and having electrodes and electric-circuit connections therewith, two chambers to be charged with fuel, flues connecting the electric smelting chamber intermediate with the fuel chambers, and means for causing a reversing flow of an aëriform fluid through the fuel chambers and the intermediate electric smelting chamber. (2) The combination in a furnace, of an electric smelting chamber having electrodes and electric-circuit connections therewith, a pair of hot-blast stoves, and a pair of fuel chambers, with flues connecting the hot-blast stoves with the fuel chambers and the latter with the electric smelting chamber, means for reversing the flow of gases, together with valves therefor, whereby a reversing flow of hot gases can be sent through the fuel chambers and the smelting chamber, as and for the purpose set forth.

658,473. Chuck, *W. D. F. Smith and T. Coventry, Manchester, England.—Filed January 22nd* 1900.

Claim.—(1) In a chuck, the combination with a hollow spindle and a plurality of tapered gripping jaws co-operating therewith; of a sleeve longitudinally slideable on the spindle, and a ring adjustable in said sleeve and arranged to positively move the jaws into and out of the spindle, substantially as set forth. (2) In a chuck, the combination with a hollow spindle, of a sleeve provided with an external bead on one end, longitudinal slots ending at the base of the bead,

658,473

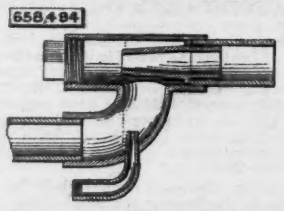


double toggle levers in said slots whose ends slide against the ends of said slots to move the sleeve, an internal threaded flange on the other end of said sleeve, conical-surfaced jaws, peripheral grooves therein, a threaded adjusting ring in said internal flange, a flange in said ring adapted to engage the grooves in the jaws and hold and adjust the same, and mechanism for moving the levers, sleeve, ring, and jaws, substantially as described.

658,494. Track-sanding Device, *J. H. Watters, Anniston, Ala.—Filed July 21st*, 1900.

Claim.—(1) A track-sanding device comprising a casing having an arm designed to be connected with a sand-box, an inner tube or nozzle extending to the top of the opening of the arm and adapted to prevent sand from passing directly through the casing, and an air tube communicating with the casing and adapted to force the sand above the inner tube or nozzle, substantially as described. (2) A track-sanding device comprising a casing having an arm designed to be connected with a sand-box, an inner tube arranged within the casing and extending to the top of the opening of the arm, and an air tube extending through the arm, and provided with a nozzle located within the arm at a point below the upper end of the inner tube, and adapted to force the sand into the upper portion of the casing to cause the same to be forced through the inner tube, substantially as described.

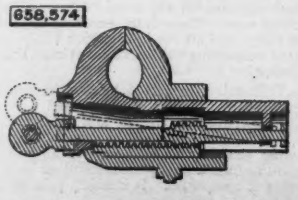
658,494



658,574. Vice, *V. J. McDonnell, Philadelphia, Pa.—Filed January 30th*, 1900.

Claim.—(1) In a vice, a rotary and sliding operating shaft for a movable jaw thereof, and gearing for said shaft, said shaft being adapted to be geared and ungeared and shoulders at different altitudes on the wall of the opening which said shaft occupies to support the head of the shaft in elevated and lowered positions. (2) A vice consisting of a stationary jaw, a

658,574



bed supporting the same, a movable jaw, a box carrying the latter, a rack on said bed, a headed shaft in said box, a gear on said shaft adapted to mesh with said rack, said shaft being adapted to be elevated and lowered and thus disengaged from said rack, shoulders on said box at different altitudes to receive the head of said shaft in its raised and lowered positions respectively and a depending shoe in the upper side of the interior of said box on which said shaft when elevated is adapted to ride.

END OF VOL. XC.